



Labor use on livestock ranches in Montana
by George H Biddle

A THESIS Submitted to the Graduate Committee in partial fulfillment of the requirements for the degree of Master of Science in Agricultural Economics
Montana State University
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Abstract:

In the interests of society and in the interest of the individual in most cases, it is necessary that the productive units within our economic system make the most efficient use of our natural resources, and that they maintain a degree of flexibility during crucial periods. This is expected in the ranching industry as in any other. During the the present emergency period, the impact of the labor shortage has forced a test on ranchers as to the degree of flexibility that they can maintain during crucial periods. This study was proposed to determine and analyse variations in the intensity of labor use, variations in the ability to substitute other factors for labor during labor shortages, and variations in the effective seasonal use of labor, on 64 ranches in Montana, classified according to size, and type of operations for specified areas.

Of the two areas studied, the plains and the mountains, it was found that the ranchers of the plains area used labor the least intensively, and that they spread their labor most effectively over the year. No differences were observed between the ranchers of the two areas in ability to substitute other factors for labor during shortage periods.

Of the three sizes studied, the large, medium and small, it was found that the large ranchers made the least intensive use of labor, and spread it most effectively over the year, while the medium size ranchers were able to substitute other factors for labor during shortage periods to the greatest extent.

Of the three types studied, sheep, cattle and combination sheep and cattle, it was found that the sheep ranches on the average used labor the least intensively. This was primarily due to the fewer number of small sheep ranches with high labor requirements. The combination ranches were best able to substitute other factors for labor during shortage periods, and the sheep ranches made the most effective seasonal use of their labor.

It was discovered that ranchers substituted for labor quite extensively. This was accomplished by substituting poorer quality labor, capital in the form of machinery, and different types of management such as delaying inputs for future return.

LABOR USE ON LIVESTOCK RANCHES
IN MONTANA

by

GEORGE H. BIDDLE

A THESIS

Submitted to the Graduate Committee

in

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FOREWORD

In the words of John Maynard Keynes, ". . . the ideas of economists and political philosophers, both when they are right and when they are wrong, are more powerful than is commonly understood. Indeed the world is ruled by little else. Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually the slaves of some defunct economist. Madmen in authority, who hear voices in the air, are distilling their frenzy from some academic scribbler of a few years back. I am sure that the power of vested interests is vastly exaggerated compared with the gradual encroachment of ideas. . . . soon or late, it is ideas, not vested interests, which are dangerous for good or evil."

ABSTRACT

In the interests of society and in the interest of the individual in most cases, it is necessary that the productive units within our economic system make the most efficient use of our natural resources, and that they maintain a degree of flexibility during crucial periods. This is expected in the ranching industry as in any other. During the the present emergency period, the impact of the labor shortage has forced a test on ranchers as to the degree of flexibility that they can maintain during crucial periods. This study was proposed to determine and analyze variations in the intensity of labor use, variations in the ability to substitute other factors for labor during labor shortages, and variations in the effective seasonal use of labor, on 64 ranches in Montana, classified according to size, and type of operations for specified areas.

Of the two areas studied, the plains and the mountains, it was found that the ranchers of the plains area used labor the least intensively, and that they spread their labor most effectively over the year. No differences were observed between the ranchers of the two areas in ability to substitute other factors for labor during shortage periods.

Of the three sizes studied, the large, medium and small, it was found that the large ranchers made the least intensive use of labor, and spread it most effectively over the year, while the medium size ranchers were able to substitute other factors for labor during shortage periods to the greatest extent.

Of the three types studied, sheep, cattle and combination sheep and cattle, it was found that the sheep ranches on the average used labor the least intensively. This was primarily due to the fewer number of small sheep ranches with high labor requirements. The combination ranches were best able to substitute other factors for labor during shortage periods, and the sheep ranches made the most effective seasonal use of their labor.

It was discovered that ranchers substituted for labor quite extensively. This was accomplished by substituting poorer quality labor, capital in the form of machinery, and different types of management such as delaying inputs for future return.

LABOR USE ON LIVESTOCK RANCHES IN MONTANA

CHAPTER I.

BACKGROUND: PROBLEM AND METHOD OF ANALYSIS

THE PROBLEM

In order for a business or production firm to exist in our constantly changing economic world, the operator must continuously make changes to meet varying circumstances. This is especially true in the process of production. It is the purpose of this study to show how and to what extent ranchers, as production operators, are able to meet recurring fluctuations in the form of a shortage of one of the factors of production, namely, labor.

It is impossible for a business or productive industry to settle down strictly to a routine of using the same tools day after day, of working the same men day after day, and of producing the same product in the same amount day after day. The dynamic aspect of our economic society prompts some of the laborers employed by the business men to quit their jobs for a better position elsewhere. People are constantly demanding new types and kinds of consumption goods. Price fluctuations cause variations in the productive or business scheme. Competition forces him to invest in up-to-date capital goods, to install new machines and fixtures, to replace worn out or obsolete equipment, and to adapt new methods and techniques of management in order that he may maintain his status as an operator of a production or business firm.

The extent by which the business man uses efficiently ^{1/} the factors of production including land, labor, capital, and management, and the degree of flexibility ^{2/} by which he keeps up with this changing aspect determines whether or not he is successful.

The same is true of livestock production on the Great Plains of the West. In fact, these varying circumstances take on added significance as is the case of most agricultural enterprises, for such enterprises have to cope with not only variations in the inputs of purchasable or controllable factors such as labor, machinery etc., but with climatic variations as well. To further complicate the matter the rancher has to base his plans on a production period of at least two or three years in length, which is the approximate time that it takes to increase his breeding herd by growing calves or lambs into breeding stock. If during this period, prices drop, if the demand changes, or if one of the factors of production becomes scarce to the industry, the rancher stands to lose. In the case of a hat manufacturer, for example, he, on the other hand, is only obligated to plan over a period of six to

^{1/} Efficiency at this point, implies the meaning of the combination of factors in such proportions that the maximum profits are attained

^{2/} It should be emphasized, however, that flexibility can hardly be divorced from efficiency, in fact, flexibility is a criterion of efficiency, flexibility of a kind which adapts to the conditions prevailing. But, for the purpose of the study at hand efficiency in the use of factors, especially labor is to be thought of as the most efficient use during relatively normal times. Flexibility is to be considered as the ability to substitute one of the factors of production during abnormal periods of restricted use. Substitution is further discussed in Chapter III.

eight months. Should prices or styles change, he, in a relatively short time, can shift his operations and produce an entirely different style of hat in varying quantities that can be marketed to his advantage.

Comparing this situation with that of the rancher, it is quite obvious that the rancher's problems are more intensified. But, whether the problem is one of a shortage of a factor used in production, one of a price change or one of a demand for a new type of product, the rancher who is to survive and who is to obtain a profitable return for his investment is the one who is so located and so conducts his operations that a high degree of flexibility is attained, and the one who makes the most efficient use of the input services at his command. It should be emphasized that this last statement, especially applies to the Great Plains rancher, who in a high risk area is continuously subject to fluctuations, fluctuations which may mean dismal failure overnight unless provision has earlier been made to carry through the crisis, such as providing for reserves of hay.

A very fundamental and basic question that might be asked at this point is: how do ranchers meet these fluctuations? The answer is that such flexibility is attained by the process of substitution, substituting land, labor and capital, substituting methods of management, or substituting one final product for another. If one of the factors of production becomes scarce to the industry or if the price of one of the factors rises in comparison to the prices of the other factors, the rancher substitutes factors until he achieves the highest profit

combination. If one or more methods of management are more profitable than a method used by a rancher, he will substitute the more profitable technique for the less profitable. If the demand for his final product, such as beef, falls, the entrepreneur will produce a different product for which the demand is sufficient, such as mutton.^{3/} He, essentially is substituting one final product for another. Such, in a general way, is how substitution is employed by a rancher.

Labor as one of these factors of production requires numerous considerations in its employment. First, and at all times is required efficiency in its use. A second consideration evolves from the fact that often the rancher finds that his labor supply is disturbed or restricted as is the case during the present emergency period, and it is necessary to replace labor with some other factor in order that he may maintain production. A third consideration comes from the fact that labor is quite different from the other factors of production, in that the people of our society compose the labor force that is used by the rancher or any other industry. Therefore, labor cannot be treated as an inanimate object, which if not used remains stored in a warehouse where the productive entrepreneur can seek its service at will.

^{3/} The case of ranchers shifting strictly from a beef industry to a sheep industry is merely given here as an illustration of the Principle of Substitution. Actually, the elasticity of substituting beef production for sheep production completely is very low, because of the difficulty involved in such a shifting process, and because of individual preference. However, ranchers may shift to a certain degree especially in the case of combination ranchers who produce both cattle and sheep.

Consequently, an obligation arises as to its welfare throughout the year and someone has to assume this obligation whether it be society or the individual rancher.

At the present time with labor rationed to the industry through the consequences of action taken by Selective Service, and the general migration of labor to areas of high-paying jobs, the availability of labor on ranches at the needed time becomes an acute problem. An intense need has consequently developed for a knowledge of labor use on ranches throughout the state. It has become desirable for the rancher and for other agricultural industries to use the least amount of labor possible, to be able to substitute for labor to the highest degree possible, and to spread labor use out over a year's time so that effectiveness in seasonal labor use is attained to the greatest extent.

When the war is over the desirability of these characteristics will take on a different value, perhaps. For example, ranchers may be encouraged to employ as much labor as they can effectively use, as the pool of labor may be large through the consequences of unemployment. However, from past developments in social security, indications are such that social legislation will be prompted for the good of all. If such occurs, it is likely that full and efficient use of our natural resources will be stressed, which means that ranchers who use labor in the least intensive manner will be desired. Those who are able to meet fluctuations in the supply of the controllable input factors and in

prices will also be desired. And finally the type of rancher will be desired who makes the most effective seasonal use of labor.

In the realm of farm and ranch management research several questions arise in regard to this matter. Which ranchers under various conditions and situations are making the most efficient use of labor? Along with this question, which ranchers under various conditions and situations are best able to substitute for labor during shortage periods and how do the factors associated with efficiency of use and substitutability compare?

Are the ranchers who make the most efficient use of labor during normal times the ones who can substitute to a greater extent during periods of labor shortage, and are they the ones who distribute their labor use over a years time the most effectively? For example, we may observe that the cattle rancher in the plains area with a large outfit uses labor the least intensively. Can he, at the same time, when labor is restricted, make substitutions for labor and still maintain his normal production, and does he spread his labor demands evenly throughout the year so that one or two periods do not require a major share of his total labor supply? An additional question may be asked; in what ways are the ranchers able to substitute for labor during periods of restricted use?

With these troublesome questions in mind this study was conducted with the following purpose:

1. To determine variations in intensity ^{4/}of labor use for ranches according to size and type of ranch within specific areas.
2. To determine variations in the ability to substitute other factors for labor on ranches according to size and type of ranch within specific areas.
3. To determine what factors of production and what methods of management are being substituted for labor on ranches according to size and type of ranch within specific areas.
4. To determine how ranches according to size and type of ranch within specific areas, compare as to degree of intensity of labor use, as to the extent of ability to substitute, and as to the effectiveness of labor use.^{5/}

Scope and Method

For the purposes of this study 64 ranchers were interviewed to obtain primary data from which the various determinations were made and analyzed. The main analytical tool used as the basis of the study

^{4/} In referring to variations in intensity of labor use, it should be recognized that such are not the only criteria for measuring efficiency in the production of livestock. Actually, in determining which rancher or group of ranchers are making the most efficient use of the natural resources, land and capital should be taken into consideration. However, during emergency periods such as the present, from a social point of view it becomes more desirable for labor to be used in the most economical manner. Consequently, within the scope of this study, labor was the principal item of interest.

^{5/} By effectiveness in labor use is meant the degree to which labor is used by months throughout the year.

was the Principle of Substitution and upon it hangs much of the analysis proper. Its theoretical background is discussed in the following paragraphs. The measurement of intensity of labor use was made on the basis of labor months used per animal unit. Substitution ratios were determined to measure the extent to which ranchers are able to substitute other factors for labor during shortage periods.

In all of our economic activities we are continuously substituting less expensive things and less expensive ways of doing things^{6/} for that to which we attach value. The principle here involved is commonly known as the Principle of Substitution. This is a very useful analytical tool in economics, because as Marshall says, "it permeates all the economic adjustments of the modern world".^{7/}

The Principle of Substitution is especially adapted to production analysis in determining the ratios of the factors of production or input services that go into the production process. The general rule thus applied in bringing about the most profitable combination of input services, is to substitute these services one for another until the ratio of the marginal increment of the input services to their respective prices are equal. If, for example, land and labor are used to

^{6/} This can be thought of as a less expensive way of doing things or as an alternative way that involves the least sacrifice in terms of money capital or total satisfaction.

^{7/} Marshall, Alfred, Principles of Economics, 8th edition, Macmillan and Company, Limited, London, 1926, Book V., p. 405

produce potatoes, and the price of labor rises in relation to land, then land will be substituted for labor until the marginal return to both labor and land is equal to their respective marginal costs or prices.^{8/} The same applies where one of the products is rationed to the industry and where the price of the final product rises. With a rise in the price of the final product it may pay the producer to increase the scale of his enterprise, but he will be forced to restrict the use of the rationed factor and increase the inputs of the other factors. He increases the amounts of the other factors until their marginal increment is equal to their respective prices.

From an analytical sense, there are two types of substitution--static and dynamic, and within each of these types there are two subtypes--absolute and relative. Consider, for example, how a rancher conducts his managerial operations. He makes a plan covering a whole production period based on expectations of what he thinks will happen in the future, relative to prices and the available supply of input factors. In preparing this plan he substitutes one factor for another under his determination of the most profitable plan results. Such is considering substitution from a static viewpoint. As he places this plan in operation, unforeseen conditions arise and he again substitutes to meet these varying circumstances. This type of substitution is

^{8/} For a more detailed account of substitution, see Boulding, Kenneth E., Economic Analysis, Harper and Brothers, New York, 1941, pp. 489-501.

a dynamic process, where substitution is exercised to meet varying circumstances during the production period. Within each of these each of these major types of substitution, absolute and relative substitution occur. Absolute substitution is apparent in a case where the same amount of a given factor such as labor is used over two periods, but where in the latter period an increase is made in the proportion of another factor that is used with the given factor in a production process. Relative substitution is the case where the given factor is decreased in the amount used over two production periods, and where the proportion of a second factor used in the production process is increased.

The Principle of Substitution is used as the primary analytical tool for this study. As was outlined in the introduction, the main purpose was to determine how and to what extent ranches in Montana can substitute other factors for labor during shortage periods. Primary concern is given to substitution from the relative dynamic point of view. Supplementing this, determinations and comparisons were made relative to substitutability, intensity and effective seasonal use of labor.

The data analyzed for this study were taken from farm and ranch labor records the majority of which were collected by the author and others of the Montana Experiment Station staff throughout the State of Montana in the summer and fall of 1942. Some of the records used

for this study were gathered by Vocational Agricultural Instructors for a farm and ranch labor study sponsored by the Agricultural Economics Department of the Montana Experiment Station.

Of the total farms and ranches interviewed, 64 were classified as ranches on a two-thirds income basis. These 64 ranch labor records were used as the primary source data for this study. The information was taken from the original schedules and placed on cards from which the data were arranged, classified and cross tabulated.

To obtain a relative idea as to the representativeness of the sample the various distributions by size and type were compared to Census material and to another study based upon a larger number of ranches. It was discovered that the sample was heavily weighted with small and large ranches. The medium sized ranches were least represented in the sample. (See Tables I and II.)

It was also discovered that the sample was not representative in regard to type of ranch; i.e., cattle, sheep or combination, when comparing the sample with 9130 ranches used by Michaelsen^{9/} in a study on size, income and organization of ranches. (See Table III.) Also, it was found that the sample was not entirely representative of the areas from which it was taken in that by a study of Michaelsen's tables^{10/} it was discovered that from a universe of 9130 ranchers

^{9/} Michaelsen, Leon C., Size, Income and Organization of Ranches, Montana State College Thesis, Bozeman, Montana, 1938, p. 38.

^{10/} Ibid, p. 27.

TABLE I.-- NUMBER OF RANCHES IN SAMPLE, NUMBER OF RANCHES IN UNIVERSE*, AND PERCENT OF MONTANA RANCHES INCLUDED IN SAMPLE ACCORDING TO SIZE OF RANCH, MONTANA, 1942

Size (acres)	Number of ranches in sample	Number of ranches in universe	Percent of Montana ranches in- cluded in sample
Under 3	0	74	0
3-99	1	45	2.22
100-259	9	331	2.72
260-499	5	742	0.67
500-999	11	1,519	0.72
1,000-4,999	22	3,375	0.65
5,000-9,999	6	508	1.18
10,000 & over	10	328	3.05
All Sizes	64	6,922	0.92

*Data taken from U. S. Dept. of Commerce, Fifteenth Census of the United States, Agr. Vol. III, Part 3, (Western States), 1930, p. 100.

TABLE II.-- COMPARISON OF THIS SAMPLE WITH THAT OF 9130 RANCHES USED IN STUDY CONDUCTED BY LEON C. MICHAELSEN,* ACCORDING TO SIZE OF RANCH, MONTANA 1942

Size of ranch (animal units)	Percent of ranches Michaelsen's sample	Percent of ranches this sample
1-99	29.4	48.4
100-299	48.8	29.7
300 & above	21.8	21.9
All Sizes	100.0	100.0

*From Michaelsen, Leon C. Size, Income, and Organization of Ranches, Montana State College Thesis, Bozeman, Montana, 1938, p. 43.

TABLE III.-- COMPARISON OF THIS SAMPLE WITH THAT OF 9130 RANCHES USED IN STUDY CONDUCTED BY LEON C. MICHAELSEN*, ACCORDING TO TYPE OF RANCH, MONTANA

Type of ranch	Percentage distribution of Michaelsen's sample	Percentage distribu- tion of this sample
Sheep	17.3	26.6
Cattle	70.1	42.2
Combination	12.6	31.2
All Types	100.0	100.0

*From Michaelsen, Leon C., Size, Income, and Organization of Ranches, Montana State College Thesis, Bozeman, Montana, 1938, p. 38.

there were 5998 ranches on the plains and 3132 from the mountains compared to this sample of 22 ranches from the plains and 42 from the mountains. For the purposes of this study and based upon variations in ranch labor use, the state was divided into two areas, the plains area and the mountains area. The dividing line was based upon the type of farming analysis conducted by Johnson and Saunderson.^{11/} The type of farming areas included in the plains group were numbers 1, 3, 4, 5, 6, and 7. Those included in the mountains group were numbers 2, 8, and 9. (See figure 1.)

The size groupings were divided on the following basis in terms of animal unit: one cow -- 1 animal unit, one steer or heifer -- .75 animal units, one ewe -- .20 animal units, and one wether or yearling ewe -- .15 animal units.

The types of ranches were based on the following classifications: sheep, cattle, and combination cattle and sheep. The dividing lines between the class were determined on the basis of 75 percent of the animal units. If for example, a ranch had 75 percent or over of its total animal units in sheep, his ranch was classified under the sheep type.

For these 64 ranches according to size and type of ranch for specific areas the intensity of labor use was determined in terms of

^{11/} Johnson, Neil W. and Saunderson, M. H., Types of Farming in Montana, Mont. Exp. Sta. Bul. No. 328, Bozeman, Montana, October, 1936.

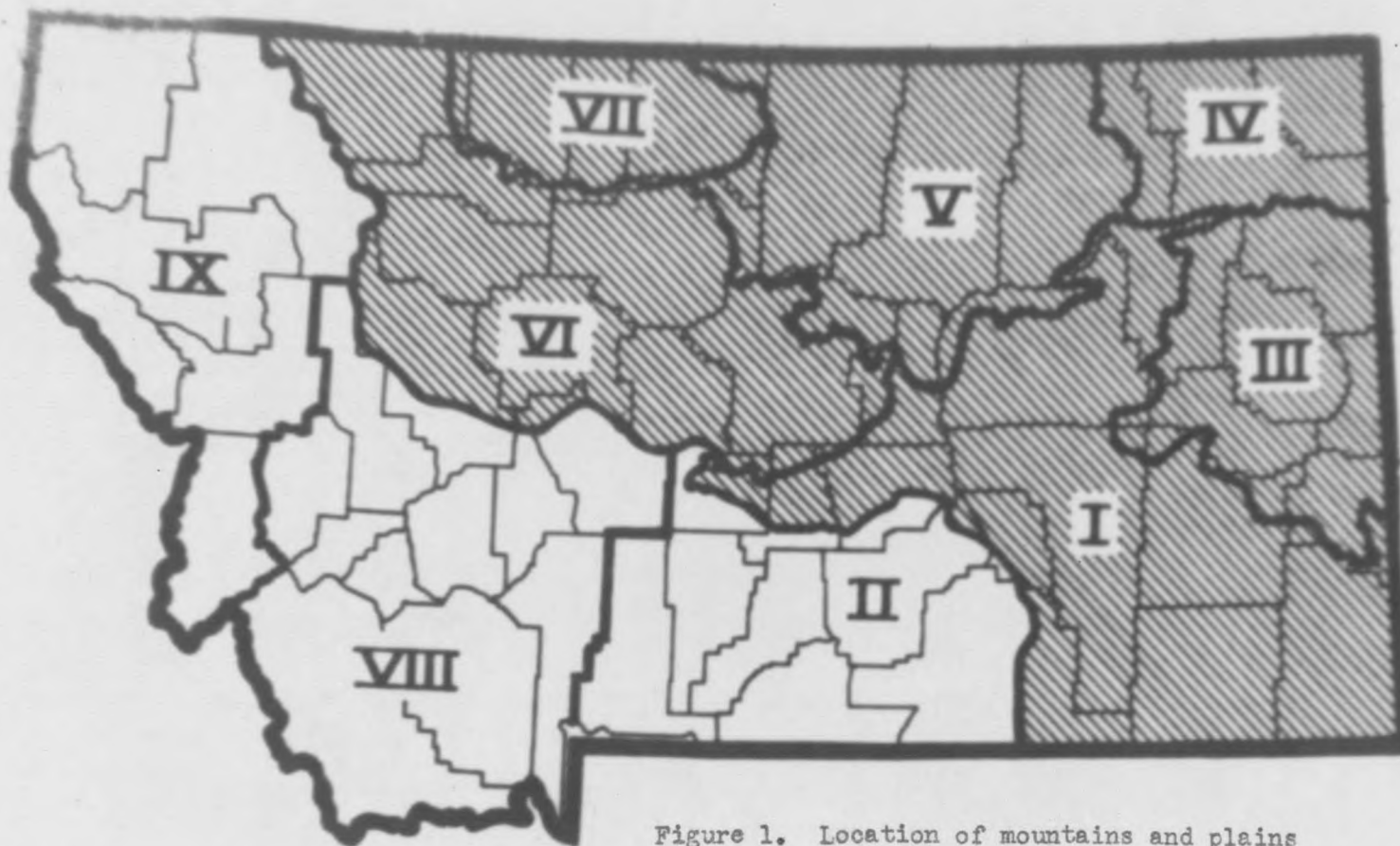


Figure 1. Location of mountains and plains areas in Montana.

labor months required per animal unit. These determinations are analyzed in Chapter 2. In Chapter 3 appears the analysis of the determinations on variations in the amount of labor employed from 1941 to 1942, the variations in the number of animal units maintained from 1941 to 1943, and the variations in the ability to substitute for labor in 1942 in terms of "substitution ratios." The substitution ratio for each ranch was determined by dividing the index number of animal units in 1942 (1941 as the base) by the index number of labor months used in 1942 (1941 as the base).^{12/} Determinations on how ranches are substituting other factors for labor during the current labor shortage period appears in Chapter 4. In Chapter 5 comparisons are analyzed for all ranches according to size and type of ranch for specified areas in Montana, as to the intensity of labor use, as to ability to substitute other factors for labor, and as to the effective seasonal monthly labor distribution.

It should be recognized that the sample used for this study in some respects is not representative, and this fact should be kept in mind in reading the manuscript. However, this does not indicate by any means the conclusions are not valid, for throughout the analysis cognizance is taken of the respects where the sample is not representative.

^{12/} See Chapter 3 for a more detailed account of the substitution ratio.

CHAPTER II.

FACTORS ASSOCIATED WITH INTENSITY OF LABOR USE

INTRODUCTION

The purpose of this chapter is to analyze the association of various factors with variations in intensity of labor use. The principal factors given attention are size of ranch, type of ranch, and location. The calculation to be employed to determine the factors associated with variations in intensity of labor use is the ratio of man labor months used to maintain one animal unit. By a method of cross tabulation, the variations in ratios of man labor months used per animal unit have been determined for different areas, for different size groups, and for different types of operation.

This material will not only be of use to the individual rancher but will also be of use to the public administrator in directing action programs and giving direction to agricultural policy. The rancher in starting up a business or while he is conducting his ranching business, is often confronted with problems of deciding upon what type of ranch he should undertake, what size of ranch he should attempt to maintain, and where he should be located to make the most efficient use of his own managerial ability and of the productive factors that he may have at his disposal or those which he is capable of employing. A determination of which of the factors mentioned above has the most effect upon the degree of labor use and the extent of such, will aid in making such decisions.

The public administrator is primarily concerned with making the

most efficient use of our natural resources, as well as with the welfare of the people concerned. It is vital for him to know which of the factors, size, type or location of ranches are most influential in minimizing the intensity of labor use, and to what extent, so that he may make wise decisions as to where available labor should be allocated, and as to what ranches should be encouraged in order to build a strong and efficient agricultural economy.

AREA AND LABOR USE

The first factor that is given consideration is location.^{13/} For the purposes of this analysis the state was divided into the plains and the mountains regions. This grouping was based upon differences in climate, soil, topography, vegetation and other physical factors which naturally affect the intensity of labor use and the ability of ranchers to substitute other factors for labor during shortage periods. It should be recognized that there are sharp differences in the physical environment that are in a degree peculiar to each ranch which affect his methods of operation and, consequently, his methods of labor use. It is important, then, that each rancher adapt his management to the specific environmental

^{13/} The information describing the areas used in this study was taken, primarily from the following:

Saunderson, M. H. and Vinke, Louis, The Economics of Range Sheep Production in Montana, Mont. Agr. Exp. Sta. Bul. 302, Bozeman, Montana, June, 1935.

Johnson, Neil W. and Saunderson, M. H., Types of Farming in Montana, Mont. Agr. Exp. Sta. Bul. 328, Bozeman, Montana, October, 1936.

Saunderson, M. H. and Chittenden, D. W., Cattle Ranching in Montana, Mont. Agr. Exp. Sta. Bul. 341, Bozeman, Montana, May, 1937.

factors that characterize his ranch, in order that he may obtain maximum output and returns to management. If the study were to be complete, it would be necessary to group the ranchers into areas no larger than townships and to study the physical factors that are peculiar to each township. Even then, one would have to take special precaution in making his dividing lines. In making use of the results at hand the only recourse for the rancher is to apply the situations described to his individual ranch, and use his own judgment in making adjustments that are necessary for his individual case.

The mountains area, as outlined in this study, comprises approximately two fifths of the total land area of the state. Its topography is characterized by rough mountain ranges, productive valleys and foothills with an elevation ranging from 3000 to 7000 feet. The surface structure varies from rocky formations on the mountains to the productive silts and clay soils of the valleys. In spite of the fact that a large share of the mountain slopes are gravelly and contain little humus, vegetation of a kind that is particularly valuable for livestock grazing thrives well. The lower valleys have developed soil containing more humus and consequently, provide hay for winter feeding.

The mean annual rainfall of the specific sections included in the mountains region vary from $8\frac{1}{2}$ to 22 inches with 15 inches as an approximate average. These differences cause considerable variation in type of vegetation and the availability of water for livestock. However, the natural surface water, along with many springs and seepages generally

provide sufficient water. The snowfall in the mountains averages about 60 inches which means that cattle and sheep have to be fed for quite long periods in the winter, usually from 3 to 5 months. This has a decided effect on the amount of labor used. Temperature in this area averages from 39 to 46 degrees. March temperatures usually are quite favorable for lambing and calving.

The native vegetation of the mountains area consists largely of the tall grasses of which the fescues and bunch grass are most important. In addition, sage on the hills and lower mountain slopes and a large variety of edible weeds and brouse on the higher mountain slopes provide adequate grazing during the grazing season.

The plains area is quite different in many respects than the area just described. The general elevation is about 3000 feet with variations up to 5000 feet in the foothill regions next to the mountains. The northern two fifths of this area has been glaciated and the topography is level or gently rolling except in a few portions where erosion has had an effect. To the south is found rougher country such as is prevalent in the Bear Paw, Big Snowy and the Bighorn Mountains.

The soil of the whole plains area varies from the fertile glacial drift to the gravelly soils in the northern section; and from silt, clay and sandy loam to the shale, clay and gravelly soils of the southern part. Rainfall varies on the average from $11\frac{1}{2}$ to 21 inches with a mean of from 13 to 15 inches. The availability of water is more of a problem on the plains and it has been found that the ranchers have resorted to

building reservoirs and to tapping artesian wells. Snowfall is considerably less on the plains, ranging on the average from 12 to 69 inches with 36 inches as the most typical. In many instances the wind blows the snow clear on large sections making winter grazing available. In fact, the author found in a few cases in the southeastern part of the state where ranchers were depending entirely on winter grazing. Feeding periods throughout the area ranges from one to four months.

The mean temperatures on the plains are essentially the same as in the mountains, ranging from 38 to 46 degrees. However, this comparison does not carry a great deal of significance in view of the fact that the plains area is subject to more extreme fluctuations in weather conditions than is the mountain area. March temperatures often are lower and storms and winds more frequent. This makes the lambing and calving seasons especially critical on the plains, which naturally necessitates the use of more labor.

The vegetation is characterized by native grasses of the short grass type. Grama grass and buffalo grass are most prevalent. Grasses generally make rapid growth during the spring period when moisture is sufficient and dry up during the summer. Sage is quite prevalent and is often grazed quite extensively during the winter period.

The physical environmental factors just described as characterizing the two regions used in this study, naturally have an effect upon labor use. They are especially influential in causing crucial periods when labor is most needed. An example of this would be a sudden snow

storm in the peak of the lambing or calving season, which naturally would call for more individual attention and thus more labor.

With this general description of the areas as background, it is simpler to analyze the influence of location upon the intensity of labor use. The 22 ranchers from the plains used labor less intensively than the 42 ranches in the mountains. The average labor months used per animal unit was .254 in the first case and .348 in the second. (See Table IV.)

TABLE IV.-- RATIOS OF MAN LABOR MONTHS USED PER ANIMAL UNIT ACCORDING TO LOCATION OF RANCH, 64 MONTANA RANCHES, 1941

	Area		Both areas
	Plains	Mountains	
Labor months used per animal unit	.254	.348	.315
Number of ranches in sample	22	42	64

It was realized that the sample taken is not homogenous and that these results may not be entirely representative of the state. Consequently, a weighting system was set up based upon information as to numbers within the various size, type and area groups from Michaelson's study of 9130 ranches.^{14/} (See appendix tables.) Assuming that the average intensity ratio within the various groups were representative, they were thus weighted and the average labor months used in the plains ranches was .274 per animal unit compared to .344 labor months per animal unit for the

^{14/} Michaelson, Leon C., op. cit., pp. 38 and 43.

mountain ranches. Thus, the original results were not greatly changed by weighting according to numbers of ranches in the universe.^{15/}

There are a number of reasons why the ranchers on the plains use labor less intensively than those in the mountains. Foremost, is the fact that they have less snowfall and a shorter feeding season. This means that they are not required to put up as much hay in the summer time and are not required to feed as long in the winter. Both of these processes require a great deal of labor. In some places on the plains sheepmen and cattlemen alike depend entirely upon winter grazing to see them through the winter. In the mountains, it takes more labor to herd the animals since the rougher terrain means a greater likelihood of animals straying. The lambing and calving season in the mountains also requires more labor since the cows or ewes have to be fed straight through the period, while on the plains this season is generally later. It comes at a time when new grass is available and when less watching and care is required.

SIZE OF RANCH AND LABOR USE

A factor that many feel has an influence on intensity at which labor is used is size of operations. For the purposes of this study, the size of ranch has been measured in terms of animal units. The smallest size group contains all of those ranches carrying from 1 to 99 animal units. The medium size includes those ranchers running between 100 and

^{15/} When further reference is made to the term "weighted according to universe numbers" it is to be understood that the weighting system is based upon the 9130 ranches used in the Michaelsen study.

299 animal units, and the large size group includes those having 300 animal units or more.

TABLE V.-- RATIOS OF MAN LABOR MONTHS USED PER ANIMAL UNIT ACCORDING TO SIZE OF RANCH, 64 MONTANA RANCHES, 1941

	Size of ranch (animal units)			
	1-99	100-299	300 & above	All sizes
Labor months used per animal unit	.432	.276	.110	.315
Number of ranches in sample	31	19	14	64

It was concluded (See Table V.) from the sample taken that a wide variation in intensity of labor use existed in the various size groups, ranging from an average labor month use ratio of .432 per animal unit for the small size ranches through a labor use ratio of .276 for the medium size group to a ratio of .110 for the large size ranches. By weighting the group average intensity ratios according to universe numbers, as described previously, the following intensity ratios were determined, small ranches-- .371, medium size ranches-- .258, and large ranches-- .087. Thus, the range between the ratios was somewhat narrowed by the weighting process.

It is generally believed that large firms are best able to make the least intensive use of the factors of production, and these determinations verify those beliefs for ranches. In fact, from the results of the study, it is observed that the large ranches used approximately one-fourth

as much labor per animal unit as the smaller ranches. Small size ranches are usually manned by the operator and what family labor he has available. Generally, he has only the number of animal units that he himself can handle even during crucial periods with the help of a hired man or two for a short time. Therefore, there is not a great deal of planning and managing the use of his labor supply. There are slack seasons when he, although appears to be busy, is not accomplishing a great deal. Consequently, he uses more labor per animal unit than does the big rancher who has to carefully plan his work and manage his workers so that he utilizes every man month of labor fully. This explanation is often referred to as the efficiency of large scale operation and the results of the study confirm this idea in that they show that as the ranch gets larger, less labor is used per animal unit. It was impossible to determine from the data at what point the labor per animal unit would begin to increase with size.

TYPE OF RANCH AND LABOR USE

To determine variations by type of ranch the 64 ranches used in this study were divided into three distinct types -- sheep, cattle, and combination of cattle and sheep. The classes were divided on the basis of 75 percent of the animal units. If a ranch had 75 percent or over of its total number of animal units in sheep his ranch was classified as a sheep ranch, etc. From the 64 ranches, 17 were classified as sheep ranches, 27 were classified as cattle ranches and 20 were classified as combination ranches.

The average labor intensity ratios as to type of ranch were determined as follows, .218 labor months per animal unit for sheep ranches, .323 for cattle, and .388 for combination ranches. (See Table VI.) These results may seem somewhat startling at first as it is generally believed that cattle take less labor than do sheep. Upon close examination of the sample it was found that the various type groups were not representative, in that the average intensity ratio for all cattle ranches were heavily weighted by a large number of ranches in the small size group, who correspondingly had a high labor intensity ratio. By weighting according to universe numbers, the following labor intensity ratios were determined, sheep ranches-- .255, cattle ranches-- .306, and combination ranches-- .312. These results are, no doubt, more accurate, but they still indicate that sheep ranchers use less labor per animal unit.

TABLE VI.-- RATIOS OF MAN LABOR MONTHS USED PER ANIMAL UNIT ACCORDING TO TYPE OF RANCH, 64 MONTANA RANCHES, 1941

	Type of ranch			
	Sheep	Cattle	Combination	All types
Labor months used per animal unit	.218	.323	.388	.315
Number of ranches in sample	17	27	20	64

Furthermore, it was found by the author in the field that sheep ranchers need a great deal of labor during the lambing season when a large amount of individual attention and care is necessary. Cows that

are calving do not require as much care and there is not as much labor involved. In addition, sheep require herding the year round unless their range is fenced. Haying operations for both enterprises take approximately the same amount of labor. In the case of the cattle ranches, most of the labor is required during the riding and roundup season and during the winter feeding period, but the labor involved is not as great as in the case of the sheep ranches. But why do our results indicate that sheep have a lower labor intensity ratio for both the weighted and for the sample used? The answer is apparent when we examine the frequencies of the size groups. Here we find that for the small size sheep ranches the frequencies are relatively low, in fact they are smaller for both the sample and the 9130 ranches studied by Michaelsen,^{16/} than either of the other two classes. (It is to be remembered that the small ranches have a high labor intensity ratio.) The frequencies of the small cattle ranches are larger by at least three times that of any other class. This gives us basis to explain why the average intensity ratios in this study are lower for the sheep ranches. The results of the size groupings as to type of ranch are shown in Table IX.

THE EFFECT OF SIZE OF RANCH AND AREA UPON THE
INTENSITY OF LABOR USE

To determine the effect of size of operation and area on intensity of labor use the various sized groups were divided on an area basis, (See

^{16/} Michaelsen, Leon C., op.cit., pp. 38 and 43.

Table VII).

TABLE VII.— RATIOS OF MAN LABOR MONTHS USED PER ANIMAL UNIT ACCORDING TO LOCATION AND SIZE OF RANCH, 64 MONTANA RANCHES, 1941

Size of ranch (animal units)	Area					
	Plains		Mountains		Both areas	
	No. :ranches*	Ratio**	No. :ranches*	Ratio**	No. :ranches*	Ratio**
1-99	10	.396	21	.449	31	.432
100-299	6	.194	13	.314	19	.276
300 & above	6	.078	8	.134	14	.110
All sizes	22	.254	42	.348	64	.315

*Number of ranches in sample.

**Labor months used per animal unit.

In all size groups the plains area had a definite advantage in intensity, its lowest labor use ratio of .078 being from the largest size ranches. The lowest labor ratio in the mountains similarly was from the large size ranches producing with a labor use ratio of .134. Consequently, the results of our previous analysis on size and area still hold true. By weighting the various groups according to universe numbers the results obtained were not significantly different.

THE EFFECT OF TYPE OF RANCH AND AREA UPON THE INTENSITY OF LABOR USE

By dividing the various types of livestock ranches down into their respective areas it was revealed that the sheep ranches not only had the lowest labor use ratio for the whole state but that such is the case for both the plains and mountains areas. However, we should be dubious

about these results because of the large numbers of small cattle ranches included in the sample which have large labor intensity ratios. (See Table VIII.)

TABLE VIII.-- RATIOS OF MAN LABOR MONTHS USED PER ANIMAL UNIT ACCORDING TO LOCATION AND TYPE OF RANCH, 64 MONTANA RANCHES, 1941

Type of ranch	Area					
	Plains		Mountains		Both areas	
	No.	Ratio**	No.	Ratio**	No.	Ratio**
	ranches*		ranches*		ranches*	
Sheep	6	.170	11	.244	17	.218
Cattle	10	.272	17	.353	27	.323
Combination	6	.309	14	.422	20	.388
All types	22	.254	42	.348	64	.317

*Number of ranches in sample

**Labor months used per animal unit.

In both areas it was found that the combination ranches had the highest labor use ratio per animal unit, and the ratios of the labor months used per animal unit for the combination ranches were disclosed to be higher than the average labor use ratios for all ranches in either the plains or the mountains. By weighting according to universe numbers the labor use ratios of the various size groups gave results which were not significantly different except to drop the combination ranches to the lowest intensity ratio of the three types in the mountains. When taking both areas, however, the combination ranches still had the highest labor use ratio.

THE EFFECT OF SIZE AND TYPE OF RANCH UPON THE INTENSITY OF LABOR USE

To trace the effects of size and type of ranch upon the intensity of labor use, the various types of ranches in the sample were divided on a size basis. It was discovered (See Table IX.) that the cattle ranches had the lowest labor use ratio in both the small and the large size groups, but when the averages of all sheep and cattle ranches were determined, it was found that the sheep ranches had the lowest labor use ratio.

TABLE IX.-- RATIOS OF MAN LABOR MONTHS USED PER ANIMAL UNIT ACCORDING TO SIZE AND TYPE OF RANCH, 64 MONTANA RANCHES, 1941

Type of ranch	Size of ranch (animal units)							
	1-99		100-299		300 & above		All sizes	
	No. ranches	Ratio	No. ranches	Ratio	No. ranches	Ratio	No. ranches	Ratio
Sheep	1	.450	8	.277	8	.130	17	.218
Cattle	18	.352	6	.361	3	.070	27	.323
Combination	12	.551	5	.173	3	.097	20	.388
All types	31	.432	19	.276	14	.110	64	.315

*Number of ranches in sample.

**Labor months used per animal unit.

However, it was found that within the sample there were only three cattle ranches in the large size group with a low labor use ratio compared to eight sheep ranches in the same size group. However, if the results were obtained by weighting the various size and type classes by area the results would appear approximately the same. As was explained previously, these

conclusions should not be taken at full value, because of the large number of small cattle ranches with large labor intensity ratios which were included to determine the final results.

SUMMARY AND CONCLUSIONS

In order to determine the variations in the labor months used per animal unit, or the intensity ratios, the ranches were divided according to size and type of ranch for specified areas in Montana. (See Table X.) It was found from the sample used that the large size cattle ranches of the plains with a labor use ratio of .038 used labor the least intensively of all the groups studied. The results may be distorted by the fact that there was only one ranch in this group. Of all the groups studied the second lowest labor use ratio was from the large sheep ranches of the plains with a labor use ratio of .081.

The results of this sample clearly indicate that the large size ranches use labor the least intensively and it was found that the plains ranches had the lowest labor use ratio in comparison with the mountains ranches. In comparing the various types of ranches it was disclosed that the sheep ranches had a lower labor use ratio than did either the cattle or the combination ranches, mainly due to the large favorable difference in the medium size group and the fact that a large number of small cattle ranches with high intensity ratios appeared in the sample. However, the cattle ranches were shown to have the lowest intensity ratios in both the small and large size groups.

TABLE X.-- RATIOS OF MAN LABOR MONTHS USED PER ANIMAL UNIT ACCORDING TO LOCATION, SIZE, AND TYPE OF RANCH, 64 MONTANA RANCHES, 1941

Type of ranch	Size of ranch: (animal units)	Area					
		Plains		Mountains		Both areas	
		No. :ranches*	Ratio**	No. :ranches*	Ratio**	No. :ranches*	Ratio**
Sheep	1-99	1	.450	-	-	1	.450
	100-299	2	.164	6	.315	8	.277
	300 & above	3	.081	5	.159	8	.130
	All sizes	6	.170	11	.244	17	.218
Cattle	1-99	7	.321	11	.372	18	.352
	100-299	2	.219	4	.433	6	.361
	300 & above	1	.038	2	.087	3	.070
	All sizes	10	.272	17	.353	27	.323
Combination	1-99	2	.635	10	.534	12	.551
	100-299	2	.200	3	.156	5	.173
	300 & above	2	.093	1	.105	3	.097
	All sizes	6	.309	14	.422	20	.388
All types	1-99	10	.396	21	.449	31	.432
	100-299	6	.194	13	.314	19	.276
	300 & above	6	.078	8	.134	14	.110
	All sizes	22	.254	42	.348	64	.315

*Number of ranches in sample.

**Labor months used per animal unit.

CHAPTER III

FACTORS ASSOCIATED WITH SUBSTITUTABILITY

INTRODUCTION

The purpose of this chapter is to determine how the factors, size, type, and location of ranches affect the extent to which ranch operators can substitute other factors for labor during shortage periods. It was emphasized in the introduction of the thesis that it is important for any business firm to operate on a flexible basis, meeting fluctuations as they present themselves. He does this by a process of substituting other factors for a factor which circumstances make scarce to his industry. His ability to substitute determines to a large extent the profitableness of his operations over a period of years.

With labor rationed to the ranching industry during the present emergency period, labor records taken at this time can be used quite effectively to show which ranchers are able to maintain flexibility in their operations. By analyzing the variation in animal units and the variation in labor months employed for individual ranches during the years 1941 and 1942 according to size and type of ranch for specified areas, it is possible to obtain a relative measurement of the extent ranchers are able to substitute other factors for labor.

VARIATION IN ANIMAL UNITS

One of the first criteria which can be used in determining the extent to which ranchers are able to substitute other factors for labor

during shortage periods, is the extent to which their numbers of animal units have varied from normal times during the time that the factor concerned has been rationed to the industry. If the production decreased materially during that period the conclusion generally drawn would be that the business firms are not able to substitute as readily as may be desired.

The percentage variation in animal units was determined for the 64 Montana livestock ranches classified according to size, type of ranch and areas for the years 1941, 1942 and 1943. (See Table XI.) The percentages were determined on a per ranch basis and it is easily recognized that some of the large frequencies in a few of the size, type and area groups may somewhat distort the total. Table XI is so constructed, however, that the reader may observe these frequencies and form his own conclusions as to the validity of the results.

For all ranches used in the study, it was found that there was an increase of 8.5 percent in animal units from the years 1941 to 1942. The impact of labor shortage did not affect greatly the ranchers' plans for the 1942 production season. Also, the climatological conditions were very favorable for that period. Consequently, ranchers had their plans made before legislation was put into effect that would drain them of their labor supply, and it was not until the latter part of the 1942 season that the labor shortage was felt in their operations.

It was found (See Table XI.) that there was a greater increase in animal units on the plains ranches than in the mountains. Of the 64

TABLE XI.-- INDEX NUMBERS SHOWING VARIATION IN ANIMAL UNITS ACCORDING TO LOCATION, SIZE, AND TYPE OF RANCH, 64 MONTANA RANCHES, 1941-1942-1943

Type of ranch	Size of ranch (animal units)	Area											
		Plains				Mountains				Both areas			
		No.	**	**	**	No.	**	**	**	No.	**	**	**
		ran- ches	%	%	%	ran- ches	%	%	%	ran- ches	%	%	%
			42/41	43/42	43/41		42/41	43/42	43/41		42/41	43/42	43/41
Sheep	1-99	1	97.4	190.3	210.5	-	-	-	-	1	97.4	190.3	210.5
	100-299	2	95.8	50.0	50.0	6	133.4	97.7	129.1	8	124.0	85.8	109.3
	300 & above	3	109.3	59.6	90.4	5	105.3	79.9	85.4	8	106.8	72.3	87.3
	All sizes	6	102.8	78.2	97.0	11	120.6	89.6	109.2	11	114.3	85.6	104.9
Cattle	1-99	7	103.9	106.4	109.3	11	108.3	99.3	107.9	18	106.6	102.1	108.5
	100-299	2	107.0	112.6	120.7	4	102.8	108.7	111.4	6	104.1	110.0	114.5
	300 & above	1	100.0	106.1	106.1	2	83.9	81.3	66.9	3	89.3	89.5	80.0
	All sizes	10	104.1	107.6	111.3	17	104.1	99.4	103.9	27	104.1	102.5	106.6
Combination	1-99	2	167.2	148.9	247.0	10	105.3	98.3	104.4	12	115.6	106.7	128.1
	100-299	2	127.3	50.6	58.5	3	87.6	126.7	109.8	5	103.5	96.2	89.3
	300 & above	2	93.4	95.2	88.6	1	95.2	45.9	93.7	3	94.0	78.8	73.6
	All sizes	6	129.3	98.2	131.4	14	100.8	100.6	101.2	20	109.3	99.9	110.3
All types	1-99	10	115.9	123.3	147.0	21	106.9	98.8	101.5	31	109.8	106.7	116.1
	100-299	6	109.7	71.0	76.4	13	113.7	107.8	119.2	19	112.3	96.2	105.7
	300 & above	6	102.5	79.2	92.3	8	98.7	76.0	75.5	14	100.3	77.4	82.8
	All sizes	22	110.6	97.0	112.9	42	107.4	97.3	102.0	64	108.5	97.2	107.3

*Number of ranches used in the sample.

**Index number of animal units.

ranches taken from the plains area it was found that they increased their number of animal units from 1941 to 1942, 10.6 percent, as compared to a corresponding increase of 7.4 percent for the mountain ranches.

The medium size ranches with animal units numbering from 100 to 299 witnessed the greatest increase in animal units from 1941 to 1942, the results indicating a percentage increase of 12.3 percent as compared to 9.8 percent and .3 percent for the small and large ranches respectively. This indication seems quite consistent for all types of ranches especially of the cattle enterprises.

Upon further observation it was noted that the sheep ranches had an average increase of 14.3 percent in animal units for these two years as compared to average increases of 4.1 percent and 9.3 percent for cattle and combination ranches, respectively. The results further indicate that the relative low increase in cattle numbers for those two years was consistent throughout the plains and mountain areas but was especially effected by a decrease of 16.1 percent for the large size cattle ranches in the mountain areas.

Of all types of ranches it was found that the largest increase was on those ranches in the small size group on the plains, with an increase of 15.9 percent. Within the mountains area the combination ranches witnessed the largest increase which amounted to 13.7 percent. In both areas the large ranches responded least to rising prices and favorable weather conditions with a 2.5 percent increase in the plains area and a 1.3 percent decrease in the mountain area.

EXPECTED VARIATIONS IN ANIMAL UNITS FROM 1942 TO 1943

The production season of 1943 obviously will show the true effects of the labor shortage, for by the time the ranchers were planning for the 1943 production year they were taking into consideration the fact that labor would be severely rationed to their industry. The results of the study (See Table XI.) show that there is an expected decrease of 2.8 percent in all animal units on all ranches included in the sample from 1942 to 1943. Within the respective areas the plains ranchers included in this sample expected to decrease their animal units on the average by 3.0 percent and the mountain ranchers 2.7 percent.

Considering size and type of operations the small size ranchers expected an increase of 6.7 percent, the medium size ranchers a decrease of 3.8 percent, and the large size ranchers a decrease of 22.6 percent.

For 1943 the cattle ranchers of this study expected an increase of 2.5 percent in animal unit numbers over that of 1942 and the sheep and combination ranchers expected decreases of 14.4 percent and .1 percent respectively.

Without regard to type of operations the largest decrease in numbers of animal units for 1943 is expected in the large size group, with an expected percentage decrease of 22.6 percent over the number of animal units on ranches in 1942. This relatively large percentage decrease on the large ranches was consistent throughout the plains and mountain areas. The largest increase was expected on the small size ranches of the plains area, with an expected increase of 23.3 percent over the 1942 number of

animal units.

EXPECTED VARIATIONS IN ANIMAL UNITS FROM 1941 TO 1943

In order to obtain a true picture of the variations in animal units during the present crucial period and thus obtain a relative idea as to the extent ranchers are able to meet fluctuations of a kind that hamper their productive process, it is well to observe the expected variations in animal unit numbers from 1941 to 1943, using 1941 as a basis for the determination.

From the study it was discovered that there was an expected increase of 7.3 percent for all ranches studied on a per ranch basis from 1941 to 1943. This expected increase was more common on the plains where it was expected that there will be increases of 12.9 percent compared to a 2.0 percent increase in the mountains area. Of the size groups interviewed, the largest increase was expected on the small size ranches with an expectancy of a 16.1 percent increase, compared to a 5.7 percent increase in the medium size groups, and a 17.2 percent decrease on the large size ranches. The combination ranchers indicated an expectancy of increasing their animal unit numbers in 1943 by 10.3 percent over the number they had maintained in 1941, as compared to increases of 6.6 percent and 4.9 percent for cattle and sheep ranches respectively.

VARIATION IN LABOR MONTHS USED

To supplement what has already been observed regarding the variations in animal unit numbers for the years 1941, 1942 and 1943 the variations in labor months used on these various ranches from 1941 to

1942 was observed and analyzed. By comparing the percentage variation in animal units on a given ranch or group of ranches, with the variation in labor months used for two consecutive years where the labor force in most areas has been decreased, an approximation was established as to what extent ranchers are able to substitute other factors for labor.

It was discovered (See Table XII.) that very few ranches in the group classifications increased their labor supply from 1941 to 1942. The variations for the groups were expressed as percentage variations from 1941 to 1942 and the averages were determined on a per ranch basis. It is observed by noting the average variation of the labor force used for all ranches included in the study that the labor supply was decreased by 14.7 percent in this two-year period.

Within the plains area the ranches were using 13.5 percent less labor in 1942 as compared to 1941, while in the mountain area the ranches were using 15.4 percent less labor. Among the various size groups it was observed that the medium size group suffered the least decrease in their labor supply, with a decrease of 6.1 percent while the percentage decreases for the small and large sizes were 18.7 and 17.7 respectively. Within the various type of ranch groups the sheep ranches were found to have suffered the least decrease in labor months used, with a decrease of 10.6 percent, while the cattle ranches and the combination ranches suffered decreases of 18.0 percent and 13.8 percent respectively. Of the groups studied, the sheep ranches on the plains witnessed an increase of 1.3 percent in labor used for the two-year period, while the cattle ranches in

TABLE XII.-- INDEX NUMBERS SHOWING PERCENTAGE OF 1941 LABOR MONTHS USED IN 1942 ACCORDING TO LOCATION, SIZE, AND TYPE OF RANCH, 64 MONTANA RANCHES, (JANUARY-JULY)

Type of ranch	Size of ranch :(animal units)	Area					
		Plains		Mountains		Both areas	
		No.	**	No.	**	No.	**
		ranches*	% 42/41	ranches*	% 42/41	ranches*	% 42/41
Sheep	1-99	1	100.0	-	-	1	100.0
	100-299	2	114.8	6	95.3	8	100.1
	300 & above	3	120.0	5	90.6	8	97.8
	All sizes	6	109.9	11	93.1	17	99.1
Cattle	1-99	7	96.7	11	95.9	18	96.2
	100-299	2	80.6	4	85.5	6	83.8
	300 & above	1	80.6	2	108.3	3	96.1
	All sizes	10	91.9	17	94.4	27	93.5
Combination	1-99	2	98.6	10	83.3	12	85.9
	100-299	2	90.1	3	92.5	5	91.6
	300 & above	2	81.1	1	101.4	3	87.8
	All sizes	6	93.3	14	86.6	20	87.6
All types	1-99	10	97.5	21	89.9	31	92.3
	100-299	6	95.2	13	91.6	19	92.7
	300 & above	6	95.4	8	95.3	14	95.3
	All sizes	22	96.3	42	91.5	64	93.1

*Number of ranches used in the sample.

**Index number of labor months used.

the plains area suffered the greatest loss in labor months used with a decrease of 22.6 percent.

VARIATIONS IN ABILITY TO SUBSTITUTE FOR LABOR

From the foregoing analysis of this chapter the reader may obtain a relative idea as to how ranches from the groups studied were able to substitute other factors for labor during shortage periods, by comparing the variations in animal units from 1941 to 1942 with the variations in labor months used by the respective groups for this same period. However, this method is not the most effective in making a determination as to the extent they can substitute other factors for labor.

To bring the variations in animal units and the variations in labor months used, together in a compact and representative measure of substitutability, the author has originated what he calls a "substitution ratio". This substitution ratio was determined for all ranches included in the study by dividing the index number of animal units in 1942 (1941 as the base) by the index number of labor months used in 1942 (1941 as the base). For example, if a rancher increases his animal units from 1941 to 1942 by 10 percent, but the amount of labor used on his ranch was only 85 percent of what was used in 1941, his substitution ratio was $110/85$ or approximately 1.29. These individual substitution ratios were averaged for each group of ranches broken down as to size and type of ranch for specified areas. By observing the averages of all the substitution ratios (See Table XIII.) it was found that of the ranchers interviewed for the study, practically all were able to substitute other factors for

labor to quite a great extent, as the average substitution ratio was determined to be 1.277. By observing the substitution ratio of the

TABLE XIII.-- RATIOS SHOWING EXTENT TO WHICH RANCHERS ARE ABLE TO SUBSTITUTE OTHER FACTORS FOR LABOR DURING SHORTAGE PERIODS ACCORDING TO LOCATION OF RANCH, 64 MONTANA RANCHES, 1941-1942

	Area		
	Plains	Mountains	Both areas
Substitution ratio*	1.258	1.287	1.277
Number of ranches in sample	22	42	64

*The substitution ratio is the ratio obtained by dividing the index number of animal units in 1942 (1941 as the base) by the index number of labor months used in 1942 (1941 as the base).

mountain ranchers as 1.287 and the substitution ratio of the plains ranchers as 1.258 it was concluded that the difference between the two ratios was not a significant difference.

Again, it was realized that the sample taken was not entirely homogeneous and that these results may not be entirely representative of the state. As for the intensity ratios, a weighting system was set up based upon information as to numbers within the various size, type and area groups from Michaelsen's study of 9130 ranches.^{17/} (see Appendix tables.) Assuming that the average substitution ratios from the various groups within the size, type, and area classifications were representative, they were thus weighted and it was discovered that the average substitution

^{17/} Michaelsen, Leon C., *ibid.*, pp. 38 and 43.

ratios for the plains ranches was 1.266 and that for mountain ranches was 1.202. Consequently, it was concluded that there was not a significant difference between the ability of ranchers to substitute on the plains as compared to those in the mountains.

It was concluded from the sample used (See Table XIV.) that the small size cutfits with a substitution ratio of 1.346 were better able

TABLE XIV.-- RATIOS SHOWING EXTENT TO WHICH RANCHERS ARE ABLE TO SUBSTITUTE OTHER FACTORS FOR LABOR DURING SHORTAGE PERIODS ACCORDING TO SIZE OF RANCH, 64 MONTANA RANCHES, 1941-1942

	Size of ranch (animal units)			
	1-99	100-299	300 & above	All sizes
Substitution ratio*	1.346	1.243	1.170	1.277
Number of ranches in sample	31	19	14	64

*The substitution ratio is the ratio obtained by dividing the index number of animal units in 1942 (1941 as the base) by the index number of labor months used in 1942 (1941 as the base).

to substitute than either the medium size or the large size groups, with substitution ratios of 1.243 and 1.170 respectively. However, when the individual group averages were weighted according to universe numbers it was found that the medium size group had the highest substitution ratio of 1.263 compared to substitution ratios of 1.206 and 1.166 for the small size and the large size groups respectively. The difference between the substitution ratios of the small and medium size groups was actually not very great. However, the main reason for the medium size ranchers having a high substitution ratio was because they were able to increase

their livestock numbers to a greater extent between 1941 and 1942. The smaller ranchers, in most cases, use only family labor and although a number of the sons have been called to the armed services, they have found reason to increase their livestock numbers in response to higher prices and easier credit policies. In many cases of the smaller ranchers they had not built up their herds to labor and land capacity before the war, and with recent years of sufficient rainfall they were able to add to their livestock numbers without sacrificing their range to a great extent. Also, the recent good years have allowed them to accumulate reserves of hay.

Of the type of ranches studied, it was found (See Table XV.) that the combination group ranked first with a substitution ratio of 1.459

TABLE XV.-- RATIOS SHOWING EXTENT TO WHICH RANCHERS ARE ABLE TO SUBSTITUTE OTHER FACTORS FOR LABOR DURING SHORTAGE PERIODS ACCORDING TO TYPE OF RANCH, 64 MONTANA RANCHES, 1941-42

	Type of ranch			
	: Sheep	: Cattle	: Combination	: All Types
Substitution ratio*	1.225	1.175	1.459	1.277
Number of ranches in sample	17	27	20	64

*The substitution ratio is the ratio obtained by dividing the index number of animal units in 1942 (1941 as the base) by the index number of labor months used in 1942 (1941 as the base).

while the sheep ranches ranked second with a substitution ratio of 1.225 and the cattle ranches ranked third with a substitution ratio of 1.175 in the ability to substitute other factors for labor during shortage periods.

When the individual groups substitution ratios were weighted according to universe numbers, the following substitution ratios were determined, 1.415 for combination ranches, 1.211 for cattle ranches, and 1.099 for sheep ranches. These results seem more reasonable, mainly in view of the fact that cattle ranchers are not as dependent upon an adequate supply of labor during crucial times of the year as are sheep ranchers. The combination ranchers had the highest substitution ratio mainly because they increased their livestock numbers by quite a great extent in 1942 and suffered the largest percentage decrease in the labor supply. Also, the combination ranchers have increased their animal unit numbers, especially cattle, to make use of the larger hay reserves and the better range of recent years. Because they are diversified in their livestock enterprise they can increase either cattle or sheep depending upon which would make the best utilization of the resources at their command, while a cattle rancher, for example, although he had range or some other resource that could be best utilized by sheep, would not start in the sheep business because of the difficulty involved and because of his own individual preference.

To determine the extent that ranchers are able to substitute other factors for labor within various size groups for specified areas, the ranchers were divided on a size and area basis. It was found from the sample used (See Table XVI.) that the small ranches in the mountains were best able to meet the impact of the labor shortage and keep up a relative number of animal units. This is due to the good years of

TABLE XVI.-- RATIOS SHOWING EXTENT TO WHICH RANCHERS ARE ABLE TO SUBSTITUTE OTHER FACTORS FOR LABOR DURING SHORTAGE PERIODS
ACCORDING TO LOCATION AND SIZE OF RANCH, 64 MONTANA RANCHES,
1941-1942

Size of ranch (animal units)	Area					
	Plains			Mountains		
	Both areas			Both areas		
	Ratio*	No. ranches in sample		Ratio*	No. ranches in sample	
1-99	1.263	10		1.386	21	
100-299	1.239	6		1.244	13	
300 & above	1.270	6		1.095	8	
All sizes	1.258	22		1.287	42	

*The substitution ratio is the ratio obtained by dividing the index number of animal units in 1942 (1941 as the base) by the index number of labor months used in 1942 (1941 as the base).

sufficient rainfall which has allowed them to build up hay reserves and to run more animal units on their range land. This expansive ability is especially true of the small ranchers. The situation was quite reversed on the plains in that the large size ranchers had the highest substitution ratio, but it was practically the same magnitude as the substitution ratio of the small size ranchers within that area. By weighting according to universe numbers the following substitution ratios were found for the plains ranches, small ranches-- 1.183, medium size ranches-- 1.293, and the large ranches-- 1.258. For the mountain ranches, the following were determined, small ranches-- 1.252, medium size ranches-- 1.207, and the large ranches-- 1.007. Thus, it was found that the variations in ability to substitute other factors for labor ranged

in order of size from the smallest to the highest for the mountain ranches. On the plains ranches it was found that the medium size ranches were able to substitute to the greatest extent, and that the substitution ratios of the small and large size ranches were just the reverse of what they were in the mountains, indicating that the large size ranches were better able to substitute than were the small ranchers.

In order to analyze the effect that area and type of ranch had upon the degree of substitutability, the ranches were again divided on a type of ranch basis for specified areas. It was noted (See Table XVII.)

TABLE XVII.-- RATIOS SHOWING EXTENT TO WHICH RANCHERS ARE ABLE TO SUBSTITUTE OTHER FACTORS FOR LABOR DURING SHORTAGE PERIODS ACCORDING TO LOCATION AND TYPE OF RANCH, 64 MONTANA RANCHES, 1941-1942

Type of ranch	Area					
	Plains			Mountains		
	Both areas					
	Sub. ratio*	No. ranches in sample		Sub. ratio*	No. ranches in sample	
Sheep	1.022	6		1.335	11	
Cattle	1.217	10		1.150	17	
Combination	1.564	6		1.414	14	
All types	1.258	22		1.287	42	

*The substitution ratio is the ratio obtained by dividing the index number of animal units in 1942 (1941 as the base) by the index number of labor months used in 1942 (1941 as the base).

that the combination ranches on the plains had the highest substitution ratio-- 1.564, while the combination ranches in the mountains with a substitution ratio of 1.414 was the second highest within the various

size groups of both areas. In the mountains the sheep ranches held second place with a substitution ratio of 1.335, while the cattle ranches were found to have had a substitution ratio of 1.150. The situation was quite reversed for the ranches from the plains area where the cattle ranches with a substitution ratio of 1.217 held second place. The sheep ranches were found to have had the lowest substitution ratio within the area size groups, averaging only 1.022. By weighting the average substitution ratios, according to universe numbers, the relative results were not significantly different.

To complete the possible combination of ranches, they were divided on a size and type of ranch basis. The small combination ranches (See Table XVIII.) were found to have had by far the highest substitution ratio.

TABLE XVIII.-- RATIOS SHOWING EXTENT TO WHICH RANCHERS ARE ABLE TO SUBSTITUTE OTHER FACTORS FOR LABOR DURING SHORTAGE PERIODS ON LIVESTOCK RANCHES ACCORDING TO SIZE AND TYPE OF RANCH, FOR 64 MONTANA RANCHES, 1941-1942

Type of ranch	Size of ranch (animal units)							
	1-99		100-299		300 & above		All sizes	
	Sub. ratio	No. ranches in sample	Sub. ratio	No. ranches in sample	Sub. ratio	No. ranches in sample	Sub. ratio	No. ranches in sample
Sheep	.974	1	1.275	8	1.206	8	1.225	17
Cattle	1.176	18	1.285	6	.949	3	1.175	27
Combination	1.632	12	1.140	5	1.295	3	1.459	20
All types	1.346	31	1.243	19	1.170	14	1.277	64

*The substitution ratio is the ratio obtained by dividing the index number of animal units in 1942 (1941 as the base) by the index number of labor months used in 1942 (1941 as the base).

averaging 1.632. Within the small sized groups the cattle ranches had

the second largest substitution ratios averaging 1.176, and the sheep ranches had a relatively low ratio of .974. In the large size groups, the combination ranches were found to have had the second largest substitution ratio of the size and type classes, and the highest within the large size group. However, in this group the sheep ranches were second with a substitution ratio of 1.206. The ratio of the cattle ranches was .949. In the medium size groups the substitution ratios varied in the following order: cattle-- 1.285, sheep-- 1.275, and combination-- 1.140.

By weighting the average substitution ratios according to universe numbers, the relative results were not significantly different, except that the substitution ratio of the medium size sheep ranches was found to have been 1.030.

SUMMARY AND CONCLUSIONS

To determine the extent to which ranchers were able to substitute other factors for labor during shortage periods, the 64 ranches were divided according to size and type of ranch for specified areas in Montana, and substitution ratios were determined for each class. It was found (See Table XIX.) both by weighting according to universe numbers and from the results of the computations of this sample that the small size combination ranches of the plains were able to substitute other factors for labor to the greatest extent when all of the groups were compared. The substitution ratio of this group was found to have been 1.783.

It was found that there was not a great deal of difference between the mountains and the plains ranches in their ability to substitute other

TABLE XIX.-- RATIOS SHOWING EXTENT TO WHICH RANCHERS ARE ABLE TO SUBSTITUTE OTHER FACTORS FOR LABOR DURING SHORTAGE PERIODS ACCORDING TO LOCATION, SIZE, AND TYPE OF RANCH, 64 MONTANA RANCHES, 1941-1942

Type of ranch	Size of ranch :(animal units):	Area					
		Plains		Mountains		Both areas	
		No.	Sub.	No.	Sub.	No.	Sub.
		:ranches*	:ratio**	:ranches*	:ratio**	:ranches*	:ratio**
Sheep	1-99	1	.974	-	-	1	.974
	100-299	2	.861	6	1.413	8	1.275
	300 & above	3	1.145	5	1.242	8	1.206
	All sizes	6	1.022	11	1.335	17	1.225
Cattle	1-99	7	1.156	11	1.189	18	1.176
	100-299	2	1.420	4	1.217	6	1.285
	300 & above	1	1.240	3	.804	3	.949
	All sizes	10	1.217	17	1.150	27	1.175
Combination	1-99	2	1.783	10	1.602	12	1.632
	100-299	2	1.436	3	.943	5	1.140
	300 & above	2	1.473	1	.939	3	1.295
	All sizes	6	1.564	14	1.414	20	1.459
All types	1-99	10	1.263	21	1.386	31	1.346
	100-299	6	1.239	13	1.244	19	1.243
	300 & above	6	1.270	8	1.095	14	1.170
	All sizes	22	1.258	42	1.287	64	1.277

*The substitution ratio is the ratio obtained by dividing the index number of animal units in 1942 (1941 as the base) by the index number of labor months used in 1942 (1941 as the base).

factors for labor.

The results from the sample indicate that the small ranches with a substitution ratio of 1.346 had the highest substitution ratio within the various size groups, but by weighting according to universe numbers, it was found that the medium size ranchers had the highest substitution ratio. It is concluded that the differences in substitution ratios between the two size groups was not greatly significant. By both methods of computation, the large size group had the smallest substitution ratio and thus were the least able to substitute other factors for labor.

In comparing the various types of ranches, it was found both by weighting and from the results of the computations of this sample that the combination ranches were able to substitute other factors for labor to the greatest extent. The results of the sample indicate that the sheep ranchers were better able to substitute for labor than were the cattle ranchers. However, by weighting according to universe numbers it was found that the cattle ranches with a substitution ratio of 1.211 were better able to substitute other factors for labor than were the sheep ranches with a substitution ratio of 1.099. These results seem more accurate as it is known that the cattle ranchers are not as dependent upon an adequate supply of labor at crucial seasons of the year.

CHAPTER IV

HOW RANCHERS SUBSTITUTE OTHER FACTORS FOR LABOR

When times are such that one of the factors of production is rationed to an industry, such as ranching, there are several alternatives by which the operator can meet the impact. These alternatives can be thought of any analyzed by a tool in economics-- The Principle of Substitution. As was explained in an earlier part of this manuscript, primary concern is given to the relative, dynamic aspect of substitution. This is defined as the situation in which a rancher substitutes other factors for labor during the production period after he has made his plans for the combination and utilization of the factors at his command, and where the proportion of labor used (for instance) is decreased during this production period.

In the foregoing chapter determinations were analyzed as to the extent to which ranchers substituted other factors for labor during the current labor shortage period in the various ranch groups. These determinations were based on a substitution ratio that combined the variations in animal units from 1941 to 1942 and the variations in labor months employed during this same period.

The purpose of this chapter is to show how ranchers are substituting other factors for labor during the present shortage period. It should be realized that the rancher has several alternatives by which he can replace labor and his main problem is to substitute some other factor to such an extent that he is maximizing his return for management.

SUBSTITUTING DIFFERENT TYPES OF LABOR INPUT
FOR LABOR GENERALLY USED

Ranchers may meet the impact of the labor shortage by substituting a different kind of labor input, assuming that labor input this year is different from that of the following year, and that a different type of labor employed is a different input than used under normal circumstances. Thus, a rancher may substitute for labor by planning to use labor of a later date. He may do this profitably by letting improvements and repair work go until he can hire men at lower wages and in sufficient quantity. There are jobs such as constructing permanent fences, or repairing fences that would be more costly to fix now than would be the returns from the improvement or the repair.

For this study, information was gathered as to the number of ranchers who had permitted their general repair and improvements to go during the present time until labor could be hired in sufficient quantity at a low enough wage to make such action profitable. It was found (See Table XX.) of all the ranches studied that 39 percent of them were letting general repair and improvement go until a later date. This was especially true of the ranchers on the plains area, where 50 percent of them, compared to 33 percent in the mountains, were substituting for labor input of a later date. Possibly the principal reason for this was because 90 percent of the plains ranchers were found to be experiencing a labor shortage compared to 67 percent in the mountains. It was also found that approximately 9 percent of the ranchers on the plains

used only family labor, while 24 percent of the ranches used only family

TABLE XX.-- PERCENTAGE DISTRIBUTION OF RANCH OPERATORS CLAIMING INSUFFICIENT LABOR TO MAINTAIN REPAIR AND UPKEEP ACCORDING TO LOCATION OF RANCH, 64 MONTANA RANCHES, 1942

	Area		
	Plains	Mountains	Both areas
Percent of operators claiming insufficient labor	50	33	39
Number of ranches in sample	22	42	64

labor in the mountains. Ranchers who do not find it necessary to hire additional labor are more apt to find the necessary time to keep up their repair and improvements.

It was found (See Table XXI.) that the medium size group were letting their general repair and improvement go to a greater extent than either the small or the large size groups. Sixty percent of the medium size ranchers were substituting a labor input of a later date as compared to 19 percent and 50 percent for the small and large size ranches respectively.

It was found that the high percentage in the medium size group may be due to the fact that 90 percent of these operators claimed they

were experiencing a labor shortage in 1942, a percentage significantly higher than the other two groups.

TABLE XXI.-- PERCENTAGE DISTRIBUTION OF RANCH OPERATORS CLAIMING INSUFFICIENT LABOR TO MAINTAIN REPAIR AND UPKEEP ACCORDING TO SIZE OF RANCH, 64 MONTANA RANCHES, 1942

	Size of ranch (animal units)			
	1-99	100-299	300 & above	All sizes
Percent of operators claiming insufficient labor	19	60	50	39
Number of ranches in sample	31	19	14	64

Within the various type of ranches, it was found that 53 percent (See Table XIII.) of the sheep ranchers were substituting a labor input of a later date as compared to 45 percent of the combination ranchers and 26 percent of the cattle ranches. The main reason why the sheep ranches were not able to maintain repair and upkeep is because sheep require more year round attention, leaving few slack seasons during which the available labor is not required directly with the sheep. It was also found that 99 percent of the sheep operators were actually experiencing a labor shortage in 1942, which further indicates that they would have less labor to maintain repair and upkeep.

One of the methods that seemed to be used quite frequently to meet the impact of the labor shortage was exchanging help. Of all the

TABLE XXII.-- PERCENTAGE DISTRIBUTION OF RANCH OPERATORS CLAIMING INSUFFICIENT LABOR TO MAINTAIN REPAIR AND UPKEEP ACCORDING TO TYPE OF RANCH, 64 MONTANA RANCHES, 1942

	Type of ranch			
	Sheep	Cattle	Combination	All types
Percent of operators claiming insufficient labor	53	26	45	39
Number of ranches in sample	17	27	20	64

ranchers interviewed it was found that 34 percent of them were exchanging work to a greater extent in 1942 than in 1941. (See Table XXIII.) It was found that a larger percentage of the ranchers on the plains were using exchange help to a greater extent in 1942 than was the case of the mountain ranchers. Within the size groups it was found (See Table XXIV.) that the smaller ranchers were using more exchange work to a greater extent, primarily because of the closer distances between ranches, and the greater degree of association with one another. Within the type groups the combination ranches were making use of exchange work to a greater extent in 1942 than in 1941 (See Table XXV.) primarily because

TABLE XXIII.-- PERCENTAGE DISTRIBUTION OF RANCH OPERATORS EXCHANGING WORK TO A GREATER EXTENT IN 1942 OVER 1941 ACCORDING TO LOCATION OF RANCH, 64 MONTANA RANCHES

	Area		
	Plains	Mountains	Both areas
Percent of operators exchanging work to a greater extent	41	31	34
Number of ranches in sample	22	42	64

TABLE XXIV.-- PERCENTAGE DISTRIBUTION OF RANCH OPERATORS EXCHANGING WORK TO A GREATER EXTENT IN 1942 OVER 1941 ACCORDING TO SIZE OF RANCH, 64 MONTANA RANCHES

	Size of ranch (animal units)			
	1-99	100-299	300 & above	All sizes
Percent of operators exchanging work to a greater extent	44	26	36	34
Number of ranches in sample	31	19	14	64

of the diversity of their operations which allows for a variety of tasks that do not happen to fall at the same time as does their neighbor's.

This seems to indicate a more cooperative attitude among the ranchers, and the trend seems to be progressing along with the develop-

ment of cooperative grazing districts which has come into being within the

TABLE XXV.-- PERCENTAGE DISTRIBUTION OF RANCH OPERATORS EXCHANGING WORK TO A GREATER EXTENT IN 1942 OVER 1941 ACCORDING TO TYPE OF RANCH, 64 MONTANA RANCHES

	Type of ranch			
	: Sheep	: Cattle	: Combination	: All types
Percent of operators exchanging work to a greater extent	31	30	50	34
Number of ranches in sample	17	27	20	64

last few years. The rancher is generally thought of as highly independent, and as one who desires to be left to manage his own affairs. Thus, he is often opposed to government control of land or other resources, but with the government taking over many parts of our economy there is an increasing need for the rancher to divorce himself from his independent philosophy. The formation of early Livestock Associations in the latter part of the 1800's was a form of cooperative organization, but it was of a kind that assured the rancher of his independency. With the government likely to pass an increasing amount of social legislation that will insure everyone an adequate income, especially after the war, the rancher may find that he will be deprived of his labor supply, because he, in the past, has hired at relatively low wages, and in many cases for part time employment only.

With the possibility of having his lowly paid laborers taken away from him, the rancher may find a problem on his hands. His answer may

be in the form of exchanging help, and the cooperative use of labor. The increasing extent to which exchange labor is being used may be a profitable trend, whether the rancher is conscious of the fact or not. His philosophy will be accustomed to the idea, and he may find that cooperative use of labor and exchange help after the war will be an answer to one of the most critical problems that he will face.

In examining the schedules and talking to ranchers in the field it was found that practically every rancher who was hiring labor, was forced to hire less efficient labor from that accustomed to. Ranchers particularly were mentioning the fact that inexperienced labor was very undesirable as much machinery was broken and many animals were lost especially when under care of inexperienced labor. The sheep ranchers were claiming especially to be running short of experienced herders. They claim that such seems to be a natural trend and not a direct result of the war drain on the labor supply

SUBSTITUTING LAND FOR LABOR

Naturally, there is always the possibility of substituting land for labor, but in the ranching industry it is not always possible, that is, where more land is actually used, and if possible it is not always profitable for the rancher. As far as the rancher is concerned, the land market is highly monopolistic in that if land is for sale it usually is of use or value to only one man, the one who is so located that he controls the valuable water holes, or the one who is so located that the land for sale is inaccessible to anyone else. Too, there are many

ranchers who feel that it is not profitable to own or buy an additional amount of land, because of high taxes and over capitalization. Of the 64 ranches used in this study, there were only 35 that were classified as full owners, 16 of these being from the small size group, which indicates that many ranchers find it more profitable to rent land, than to own it fully.

Ranchers also find it unprofitable in many cases to seek permits because of the high fees charged by the government agencies who control a large share of the range land, and thus in many cases the ranchers have refrained from expanding their operations to the full capacity of their managerial ability.

There is always the possibility of ranchers sacrificing conservation of their range resources when prices are high, and running smaller numbers of animal units in low price years so their range can regrow itself. It seems that the ranchers follow this sort of management. They claim if they conform to certain standard carrying capacities such as advocated by the Limited Grazing practice of the Agricultural Adjustment Administration that they would go broke in a short time. The successful rancher has to be a smart and versatile man. He not only has to watch the market prices but he has to utilize all the available forage that a year's rainfall will allow. Consequently, during periods of high prices he boosts his animal units on a given piece of land, and may overgraze his range. This, however, he feels is profitable, for during years of low prices he can cut down on his number of animal units

and let his range get back in shape.

Then too, there is the variation in rainfall from year to year. The rancher seems to know pretty well the capacity of his land. As Dr. Vass states "The arguments that the rancher is not a good manager and has abused the ranges by overgrazing is not well founded, for he knows that there is no profit in running livestock on overstocked ranges. The point of diminishing returns in livestock production is reached long before the plants are killed by overgrazing."^{18/} During years of favorable rainfall, he attempts to utilize the excess vegetation as much as possible by buying livestock in the spring and marketing them in the fall, or by renting or running other livestock on a share basis. His ability to increase or decrease his number of animal units with varying prices and rainfall determines the amount of profit he will make. If he is hampered by government control his profits are likely to decrease.

Consequently, indications are such that ranchers at the present time are substituting land for labor to the extent that they are making more intensive use of their land, that is they are running more animal units where the labor shortage is not prohibiting such, in response to higher prices brought about by the war activities. Then too, they are increasing their number of animal units because of the favorable rainfall during the past few years. However, there naturally is a point of

^{18/} Vass, A. F. Control and Value of Western Grazing Lands, Published and Distributed by American National Live Stock Association, Wyoming Stock Growers Association, and Wyoming Wool Growers Association, 1941, p. 7.

diminishing returns beyond which they dare not go. This point now is not set by the capacity of the land as much as it is set by the availability of the labor supply. This is especially true of the sheep operators, where the labor shortage is more acute, in that a greater amount of individual attention is needed with sheep than with cattle.

Data gathered for this study was insufficient to show how ranchers were actually substituting land for labor. These remarks were summarized from notes taken in the field by the author. However, the field of land utilization and land control has a great deal of promise for further research and study, especially in Montana.

SUBSTITUTING CAPITAL FOR LABOR

The rancher often finds it profitable to substitute capital, in the form of machinery or other capital goods for labor. The present labor shortage period has caused many ranchers to do this very thing. In the study at hand, data was gathered and compiled to show to what extent ranchers were substituting capital in the form of animal units for labor. It was found (See Table XXVI.) that 67 percent of all the ranchers included in the survey were running more animal units in proportion to labor employed in 1942 than in 1941. This was especially true of the plains area where 73 percent of the ranchers were substituting capital stock in the form of animal units for labor, as compared to 50 percent of the mountain ranchers. It was found (See Table XXVII.) that a larger percentage of the medium sized ranchers were running more animal units in proportion to labor used than either the small or the large size

TABLE XXVI.-- PERCENTAGE DISTRIBUTION OF RANCH OPERATORS SUBSTITUTING OTHER FACTORS FOR LABOR IN 1942 ACCORDING TO LOCATION OF RANCH, 64 MONTANA RANCHES

	Area		
	Plains	Mountains	Both areas
Percent of operators substituting other factors for labor	73	50	67
Number of ranches in sample	22	42	64

TABLE XXVII.-- PERCENTAGE DISTRIBUTION OF RANCH OPERATORS SUBSTITUTING OTHER FACTORS FOR LABOR IN 1942 ACCORDING TO SIZE OF RANCH, 64 MONTANA RANCHES

	Size of ranch (animal units)			
	1-99	100-299	300 & over	All sizes
Percent of operators substituting other factors for labor	68	79	50	67
Number of ranches in sample	31	19	14	64

groups. It was also found that more of the sheep ranchers were able to substitute capital in the form of animal units than either the cattle or combination ranchers. (See Table XXVIII.) However, the differences are not significant and it was concluded that the same percent of all three types of all three types of ranchers were substituting this type of capital for labor.

Although in many parts of the state ranchers use less machinery

TABLE XXVIII.-- PERCENTAGE DISTRIBUTION OF RANCH OPERATORS SUBSTITUTING OTHER FACTORS FOR LABOR IN 1942 ACCORDING TO TYPE OF RANCH, 64 MONTANA RANCHES

	Type of ranch			
	Sheep	Cattle	Combination	All types
Percent of operators substituting other factors for labor	71	67	70	67
Number of ranches in sample	17	27	20	64

than other types of agricultural production industries, it was found that ranchers recently were depending more upon machinery, especially for haying, to take the place of labor. Many ranchers claimed that power buck rakes and power mowers aided greatly in the reduction of the number of men required at haying time. It was discovered that 44 percent of the ranchers were using more machinery in 1942 than in 1941 which obviously was a method of meeting the impact of the labor shortage. It was found that 50 percent (See Table XXIX.) of the ranchers on the plains were substituting machinery for labor in 1942 compared to 40 percent of the ranchers in the mountains. This is primarily due to the fact that ranchers on the plains operate quite extensively making the use of large machinery more successful. This is indicated by the fact that the average size of ranch on the plains was 18,989 acres and 4,483 acres for the mountain ranches. These acreages include range land.

Within the size groups (See Table XXX.) it was found again that the medium size ranchers were substituting capital in the form of machinery

TABLE XXIX.-- PERCENTAGE DISTRIBUTION OF RANCH OPERATORS USING MORE MACHINERY IN 1942 THAN IN 1941 ACCORDING TO LOCATION OF RANCH, 64 MONTANA RANCHES

	Area		
	Plains	Mountains	Both areas
Percent of operators using more machinery	50	40	44
Number of ranches in sample	22	42	64

TABLE XXX.-- PERCENTAGE DISTRIBUTION OF RANCH OPERATORS USING MORE MACHINERY IN 1942 THAN IN 1941 ACCORDING TO SIZE OF RANCH, 64 MONTANA RANCHES

	Size of ranch (animal units)			
	1-99	100-299	300 & above	All sizes
Percent of operators using more machinery	35	53	50	44
Number of ranches in sample	31	19	14	64

to a greater extent than either the small or the large ranchers. The difference in percent of such operators between the medium and the large size groups is not a significant difference and it was concluded that within the two groups the percent of operators increasing the number of machines was approximately the same. It was found (See Table XXXI.) that a larger percent of the sheep ranches were substituting machinery than either the cattle or the combination ranchers. The data indicated that a larger percent of the combination ranchers were substituting

machinery for labor than the cattle ranchers.

TABLE XXXI.-- PERCENTAGE DISTRIBUTION OF RANCH OPERATORS USING MORE MACHINERY IN 1942 THAN IN 1941 ACCORDING TO TYPE OF RANCH, 64 MONTANA RANCHES

	Type of ranch			
	: Sheep	: Cattle	: Combination	: All types
Percent of operators using more machinery	59	30	50	44
Number of ranches in sample	17	27	20	64

SUBSTITUTING DIFFERENT METHODS OF MANAGEMENT FOR LABOR

Possibly one of the foremost methods by which the rancher is substituting for labor comes under the realm of management. There are a number of things he can do by employing different managerial practices that will maintain a sufficient output, especially at a time when market prices for his product are relatively high.

In the study a determination was made as to the percent of operators who were decreasing their crop and hay acreage in 1942 over 1941. It was discovered that 22 percent (See Table XXXII.) of the ranchers included in the survey had decreased their crop and hay acreage substantially. The differences between the plains and the mountain ranches was not significant. Within the size groups (See Table XXXIII.) it was found that a larger percentage of the ranches included in the study were decreasing their crop and hay acreage in the medium size group than

TABLE XXXII.-- PERCENTAGE DISTRIBUTION OF RANCH OPERATORS DECREASING CROP AND HAY ACREAGE IN 1942 OVER 1941 ACCORDING TO LOCATION OF RANCH, 64 MONTANA RANCHES

	Area		
	Plains	Mountains	Both areas
Percent of operators decreasing crop and hay acreage	23	21	22
Number of ranches in sample	22	42	64

TABLE XXXIII.-- PERCENTAGE DISTRIBUTION OF RANCH OPERATORS DECREASING CROP AND HAY ACREAGE IN 1942 OVER 1941 ACCORDING TO SIZE OF RANCH, 64 MONTANA RANCHES

	Size of ranch (animal units)			
	1-99	100-299	300 & above	All sizes
Percent of operators decreasing crop and hay acreage	16	37	15	22
Number of ranches in sample	31	19	14	64

any of the other groups. As to type of operations it was found that (See Table XXXIV.) the percent of the sheep ranchers and the cattle ranchers decreasing their crop and hay acreage was the same -- 29 percent, while only 15 percent of the combination ranches were cutting down on their crop and hay acreage.

All over the state, the author found that ranchers were complaining of not being able to get their regular work done on time.

TABLE XXXIV.-- PERCENTAGE DISTRIBUTION OF RANCH OPERATORS DECREASING CROP AND HAY ACREAGE IN 1942 OVER 1941 ACCORDING TO TYPE OF RANCH, 64 MONTANA RANCHES

	Type of ranch			
	Sheep	Cattle	Combination	All types
Percent of operators decreasing crop and hay acreage	29	29	15	28
Number of ranches in sample	17	27	20	64

The majority of these complaints came from operators who could not get their hay up when it was in its best condition. In many cases ranchers had to let some of their haying go entirely, expecting to utilize it in the fall for pasture, at least, as much of it as possible. Many of the operators claimed that because of the delay in haying operations the hay would become coarse and not as palatable and would not have sufficient nutritive value. When the data was compiled it was discovered that 45 percent of the ranchers included in the survey claimed to have insufficient labor to complete general ranch work on time. (See Table XXV.) This was especially true of the ranchers on the plains where 68 percent of them claimed insufficient labor to complete their general ranch work on time. This was only true of 33 percent of the mountain ranchers studied. The principal reason for the fact that ranchers were not getting their general work done on time was the fact that the unusually good season of 1942 brought with it an increase in the amount of vegetation that could be stacked for winter feed. In many cases it

TABLE. XXXV.-- PERCENTAGE DISTRIBUTION OF OPERATORS CLAIMING INSUFFICIENT LABOR TO COMPLETE GENERAL RANCH WORK ON TIME IN 1942 ACCORDING TO LOCATION OF RANCH, 64 MONTANA RANCHES

	Area		
	Plains	Mountains	Both areas
Percent of operators claiming insufficient labor to complete general ranch work on time	68	33	45
Number of ranches in sample	22	42	64

was observed that ranchers on the plains were still haying in the latter part of August.

Within the size and type groups, it was found that a larger percent of (See Table XXXVI.) medium sized ranchers and sheep ranchers were

TABLE XXXVI.-- PERCENTAGE DISTRIBUTION OF OPERATORS CLAIMING INSUFFICIENT LABOR TO COMPLETE GENERAL RANCH WORK ON TIME IN 1942 ACCORDING TO SIZE OF RANCH, 64 MONTANA RANCHES

	Size of ranch			
	1-99	100-299	300 & above	All sizes
Percent of operators claiming insufficient labor to complete general ranch work	42	58	36	45
Number of ranches in sample	31	19	14	64

claiming insufficient labor to complete their general work on time than the other size ranches and the other types of ranches, respectively. (See

Table XXXVI and Table XXXVII.)

TABLE XXXVII.-- PERCENTAGE DISTRIBUTION OF OPERATORS CLAIMING INSUFFICIENT LABOR TO COMPLETE GENERAL RANCH WORK ON TIME IN 1942
ACCORDING TO TYPE OF RANCH, 64 MONTANA RANCHES

	Type of ranch			
	: Sheep	: Cattle	: Combination	: All types
Percent of operators claiming insufficient labor to complete general ranch work on time	47	41	59	45
Number of ranches in sample	17	27	20	64

A crucial time when labor is needed especially is during the lambing and calving seasons. It is at this time when the ewes and the cows need individual attention, and this individual attention administered at the right time saves large numbers of lambs and calves. From the data compiled, it was found that 30 percent of all the ranches included in the study were experiencing a decrease in their lamb or calf crop over 1941. (See Table XXXVIII.) This was true of a larger percent of the ranchers in the plains than those in the mountains, although the differences in the percentages of the two groups was not highly significant. Within the size groups, a large percent of the large ranchers indicated that they were witnessing a decrease in their lamb or calf crops. (See Table XXXIX.) This is due, largely to the fact that the operator has to depend more upon hired help to take care of his lambing or calving than do the smaller operators.

TABLE XXXVIII.-- PERCENTAGE DISTRIBUTION OF RANCHES ON WHICH THE LAMB OR CALF CROP DECREASED IN 1942 OVER 1941 ACCORDING TO LOCATION OF RANCH, 64 MONTANA RANCHES

	Area		
	Plains	Mountains	Both areas
Percent of ranches on which the lamb or calf crop decreased	32	29	30
Number of ranches in sample	22	42	64

TABLE XXXIX.-- PERCENTAGE DISTRIBUTION OF RANCHES ON WHICH THE LAMB OR CALF CROP DECREASED IN 1942 OVER 1941 ACCORDING TO SIZE OF RANCH, 64 MONTANA RANCHES

	Size of ranch (animal units)			
	1-99	100-299	300 & above	All sizes
Percent of ranches on which the lamb or calf crop decreased	26	32	36	30
Number of ranches in sample	31	19	14	64

As to type of ranches, it was found that of the total for each group a much larger percent of the sheep operators experienced a decrease in their lamb crop than did either the cattle or combination ranches. (See Table XL.) These percentages for the different types of ranches were 53 percent of the sheep operators, 15 percent of the cattle operators, and 30 percent of the combination operators. The large number of sheep operators experiencing a decrease in their lamb crop is attributed to the

TABLE XL.-- PERCENTAGE DISTRIBUTION OF RANCHES ON WHICH THE LAMB OR CALF CROP DECREASED IN 1942 OVER 1941 ACCORDING TO TYPE OF RANCH, 64 MONTANA RANCHES

	Type of ranch			
	Sheep	Cattle	Combination	All types
Percent of ranches on which the lamb or calf crop decreased	53	15	30	30
Number of ranches in sample	17	27	20	64

fact that lambs and ewes need more attention at lambing time than do cows and calves at calving time. The fact that combination ranches showed more decreases than did the cattle ranches is because all of these combination ranchers were running some sheep.

In addition to the various systems or methods of management on which data was procured in this study, it was found that many operators mentioned that they had decreased the time spent in managing their ranch, so their own labor could be used in place of scarce hired labor. Thus, they were eliminating much of their time spent on bookkeeping, on planning their operations, and on arrangements for marketing their livestock and were doing more regular work on the ranch. A few of the ranchers indicated that their ranch was not carrying as many animal units as it was capable of, and that they had been expanding but the labor shortage caused them to decrease their operations rather than increase them. Of course, almost all of the ranchers interviewed said they seldom had any leisure time to themselves.

CHAPTER V

INTENSITY OF LABOR USE AND THE ABILITY TO SUBSTITUTE
OTHER FACTORS FOR LABOR

The purpose of this chapter is to compare the varying amounts of labor used per animal unit by different ranch groups with their ability to substitute other factors for labor, and to compare these with their monthly distribution of labor over a year's time.

It should be recognized that in the use of labor by the rancher there are two conflicting valuations or interests involved, that of the rancher himself, and that of society. For example, the individual rancher is interested in a maximum return to management, and with such a motive he in many respects neglects the interests of society and the efficiency with which the natural resources at his command are used. He may, for instance, be using a great deal of labor per animal unit and still be making profits. He may be conducting his operations in such a way that he employs twice as much labor during certain seasons of the year as he does during other seasons. He, therefore, depends upon society to employ these workers during his slack seasons so they will be available to him at his wish. If society has a program operating such that some other productive industry can take care of this labor during the ranchers' slack labor seasons, such action by the individual may be substantiated, but if this labor is to be largely unemployed throughout the season, merely to be used by the rancher at his command, then society will possibly not be in favor of the rancher taking advantage of the situation.

Whatever the interests are, the purpose of this study was to determine how various ranch groups use labor as to extent, as to variation throughout the year, and as to their ability to substitute other factors for labor during shortage periods. With results of this nature, program planners and individuals can assign their own values to each of the above considerations, and decide the type and kind of ranch desired and with the forces at their command promote that type and kind of ranch. The planner will establish programs that will make the most efficient use of the natural resources, with greatest prosperity to all, while the individual rancher within his own powers will attempt to operate the most profitable organization that best suits his individual managerial ability.

In comparing the ranches of the plains and mountain areas, it was found that the chief difference in the three comparisons made between the ranchers of the two areas was in the amount of labor used per animal unit. (See Table XLI.) The plains ranches had a labor intensity ratio of .254 compared to .348 for the mountains. The differences in substitutability did not appear to be significant. In considering seasonal use of labor it was found that mountain ranches used more labor in August than any other month, (See figure 2.) during which time 12.9 percent of the labor is used. The high peak of labor use for the plains came during the month of July when 12.2 percent of the total labor was used. Ninety percent of the plains ranchers indicated that they were short of help in 1942 while only 67 percent of the mountains ranchers indicated that they

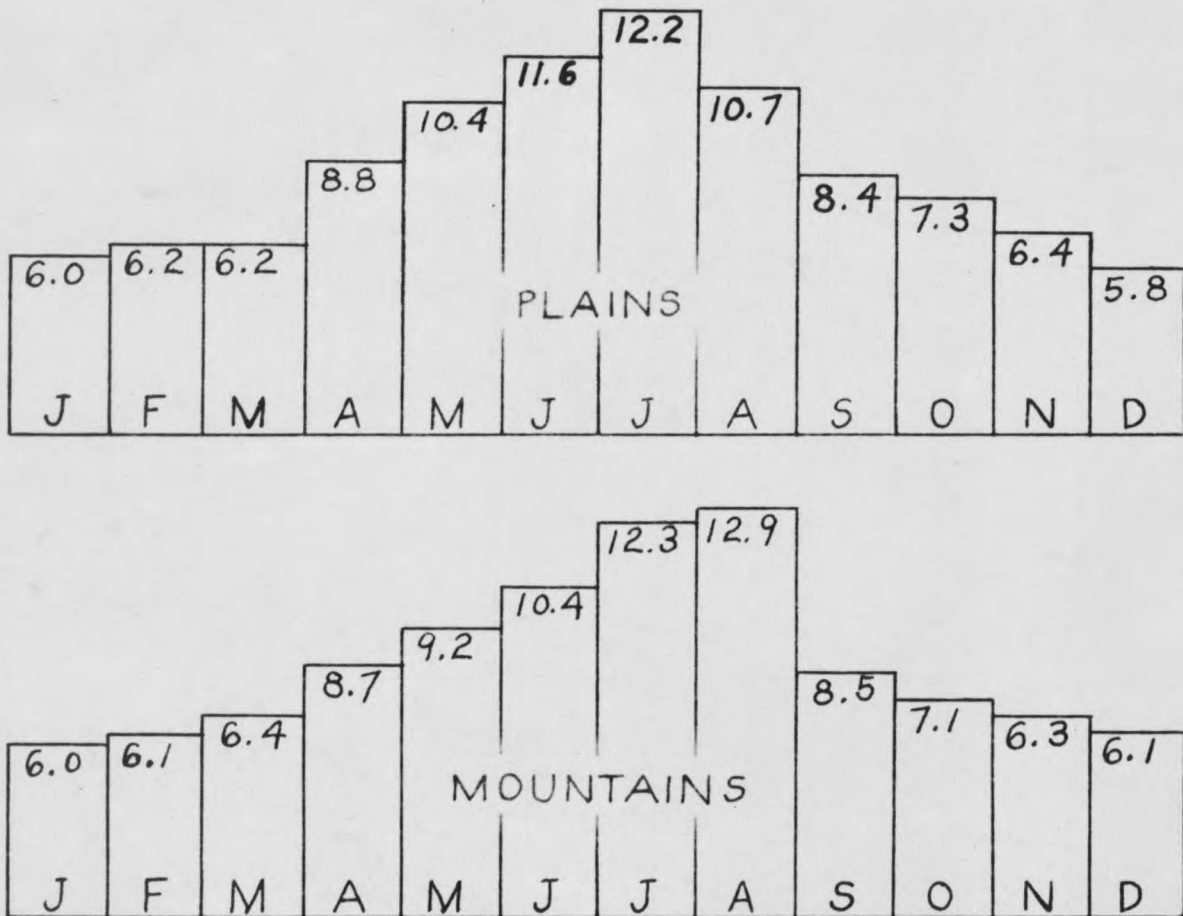


Figure 2. Percentage distribution by months of total labor used on ranches from plains and mountain areas, in 1941 for 64 Montana ranches.

TABLE XLI.-- COMPARISONS OF LABOR MONTHS USED PER ANIMAL UNIT IN 1941 AND RATIOS SHOWING ABILITY TO SUBSTITUTE OTHER FACTORS FOR LABOR IN 1942 ACCORDING TO LOCATION OF RANCH, 64 MONTANA RANCHES

	Area		
	Plains	Mountains	Both areas
Labor months used per animal unit	.254	.348	.315
Substitution ratio*	1.258	1.287	1.277
Number of ranches in sample	22	42	64

*The substitution ratio is the ratio obtained by dividing the index number of animal units in 1942 (1941 as the base) by the index number of labor months used in 1942 (1941 as the base).

were short of help. However, 60 percent of the mountains ranches in the sample were owners and 24 percent of the ranches used only family help, while 45 percent of the plains ranchers were full owners and only 9 percent of them used only family help. The average size ranch in the plains group was 18,989 acres and carrying 361 animal units with an average of 62 acres of cultivated land. The average size ranch in the mountains was smaller with an acreage of 4,483 and carrying 265 animal units with an average crop acreage of 55 acres. It is quite evident from this appraisal that the mountains ranches in this study are more stable, more of them being owners and using family labor to quite a great extent. During normal times they may hire more labor than do the plains ranchers but it is shown that they can get by quite well during shortage periods.

Within the size groups, it was found that the large size ranches (See Table XLII.) used labor the least intensively using only .110 labor

TABLE XLII.-- COMPARISONS OF LABOR MONTHS USED PER ANIMAL UNIT IN 1941 AND RATIOS SHOWING ABILITY TO SUBSTITUTE OTHER FACTORS FOR LABOR IN 1942 ACCORDING TO SIZE OF RANCH, 64 MONTANA RANCHES

	Size of ranch (animal units)			
	1-99	100-299	300 & above	All sizes
Labor months used per animal unit	.432	.276	.110	.315
Substitution ratio*	1.346	1.243	1.170	1.277
Number of ranches in sample	31	19	14	64

*The substitution ratio is the ratio obtained by dividing the index number of animal units in 1942 (1941 as the base) by the index number of labor months used in 1942 (1941 as the base).

months per animal unit, as compared to .432 and .276 labor months per animal unit, respectively for the small and medium groups. This may be partly due to differences in cultivated acreages, as it was found that the small ranches had an average cultivated land acreage of 24 acres compared to 93 acres for the medium size group and 81 acres for the large size outfits. The ratios of cultivated land acreage per animal unit were as follows: .386 acres for the small ranches, .400 acres for the medium size ranches, and .090 acres for the large ranches.

It was found that the small ranchers of the sample could substitute other factors for labor to the greatest extent with a substitution ratio of 1.346 compared to 1.243 and 1.170 respectively for the medium and large ranches. However, when the average substitution ratios for the individual ranch groups classified as to size, type and area were weighted by universe

numbers, (see appendix) it was found that the medium size ranches had the highest substitution ratio-- 1.263, compared to substitution ratios of 1.206 for the small ranches and 1.166 for the large ranches. Regardless of what may be taken as final in regard to ability to substitute for labor for the type of ranch groups, it can be said that the differences between the substitution ratios were not nearly as great as were the differences between the intensity ratios. Taking both intensity of labor use and ability to substitute into consideration, it can be said that the large ranchers substituted other factors for labor and used the least amount of labor per cow or sheep than either of the other size groups.

It was also found by comparing the seasonal labor distribution that the large size outfits distributed their labor over the year more evenly than did either of the smaller size groups. It was found that the peak loads came during May and August when for both months 11.5 percent of their total labor was used. (See figure 3.) The medium size ranches of the sample used more labor in July than any other month when 14.4 percent of their total labor was used. The small ranches used labor quite regularly throughout the summer, the peak appearing in July when 13.2 percent of the total labor was employed.

Considering type of ranch, it was found (See Table XLIII.) that the sheep ranchers used labor the least intensively with an intensity ratio of .218 labor months per animal unit, while the cattle and combination ranches used .323 and .388 labor months per animal unit, respectively. By weighting the group intensity ratios according to universe numbers the

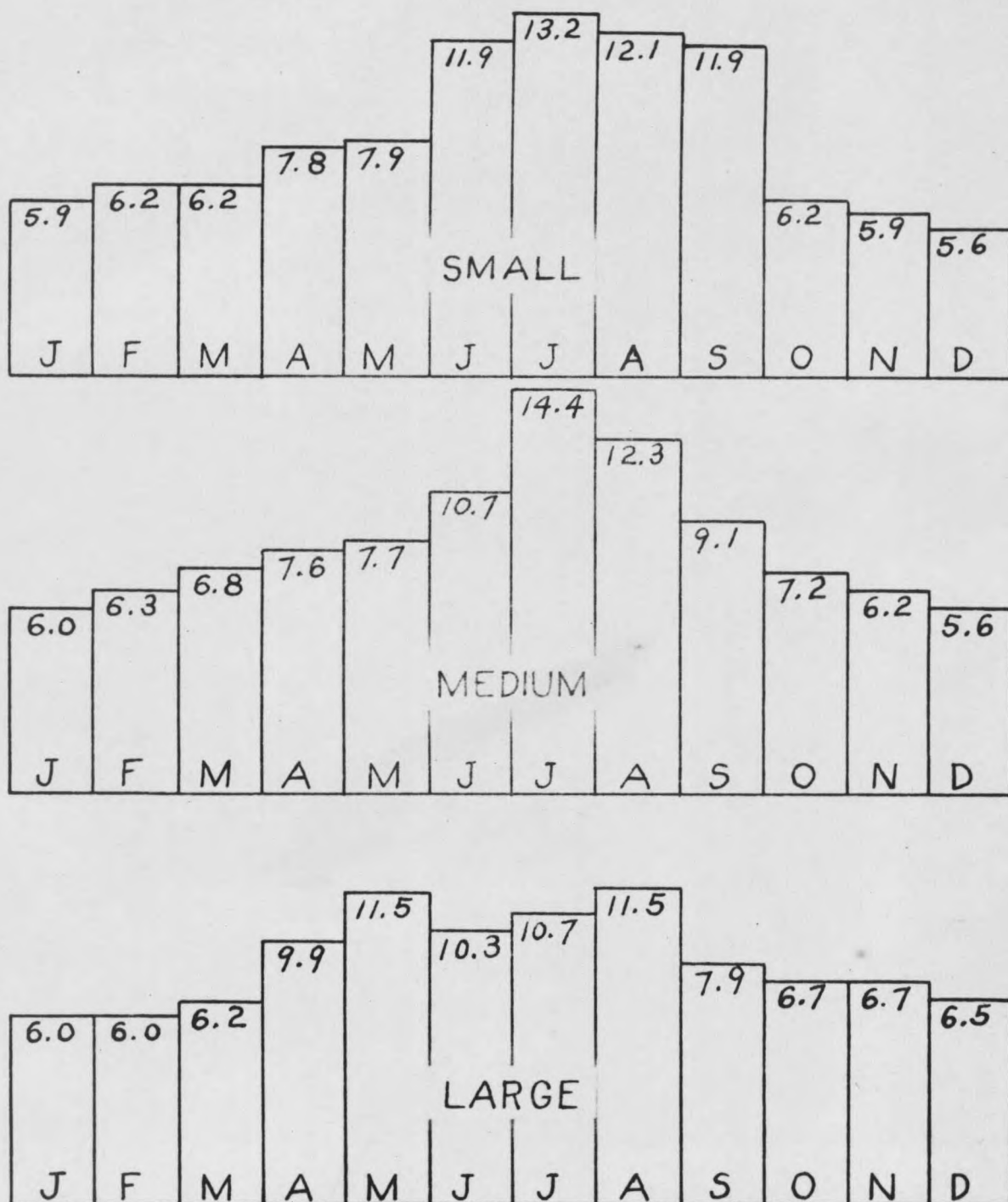


Figure 3. Percentage distribution by months of total labor used on small, medium, and large size ranches, in 1941, for 64 Montana ranches.

TABLE XLIII.-- COMPARISONS OF LABOR MONTHS USED PER ANIMAL UNIT IN 1941 AND RATIOS SHOWING ABILITY TO SUBSTITUTE OTHER FACTORS FOR LABOR IN 1942 ACCORDING TO TYPE OF RANCH, 64 MONTANA RANCHES

	Type of ranch			
	: Sheep	: Cattle	: Combination	: All types
Labor months used per animal unit	.218	.323	.388	.315
Substitution ratio*	1.225	1.175	1.459	1.277
Number of ranches in sample	17	27	20	64

*The substitution ratio is the ratio obtained by dividing the index number of animal units in 1942 (1941 as the base) by the index number of labor months used in 1942 (1941 as the base).

results were not relatively different. The main reason why the sheep ranchers had a lower labor intensity ratio than the cattle or the combination ranches was because, in the sample and in the parent population, there are relatively few small sheep ranches with high intensity ratios, while there are a large number of small ranches in the cattle and combination group, especially in the cattle group.

It was discovered that the combination ranches with the highest intensity ratios also were able to substitute other factors for labor to the greatest extent. The substitution ratio for the combination ranches was 1.459 as compared to 1.175 for the cattle ranches and 1.225 for the sheep ranches. When the average substitution ratios for the individual ranch groups were classified as to size, type and area were weighted according to universe numbers (see appendix) it was found that the combination ranches still had the highest substitution ratio-- 1.415, but

that the cattle ranches had the next highest-- 1.211 and the sheep ranches had a substitution ratio of 1.099.

In examining the seasonal labor distribution it was found that the sheep ranchers distributed their labor requirements over the year most evenly. For the five months of April through August, the labor requirements were quite consistent, (See figure 4.) with the peak appearing in May during which 11.3 percent of the total labor was used. For the cattle ranches the peak occurred in August during which 14.9 percent of the total labor was used, with little consistency appearing during the other summer months except for the fact that June, July and August required the most labor. For the combination ranches the peak occurred in July during which 14.7 percent of the total labor used was used.

Thus, it was concluded that on the average for the sample used, and putting equal emphasis on the three considerations, the sheep ranchers were best able to use labor in the least intensive manner, to substitute other factors for labor during shortage periods and to distribute their labor demands out over a year's time.

In regard to the average number of animal units the following were observed; sheep-- 687, cattle-- 157, and combination-- 157. This seems to indicate again that the sample was heavily weighted with large outfits, such being especially true of the sheep ranches. It was also observed that the sheep ranches had the smallest ratio of cultivated land acreage per animal unit with a ratio of .16 acres compared to .28 acres for the cattle ranches and .53 acres for the combination ranches. There were

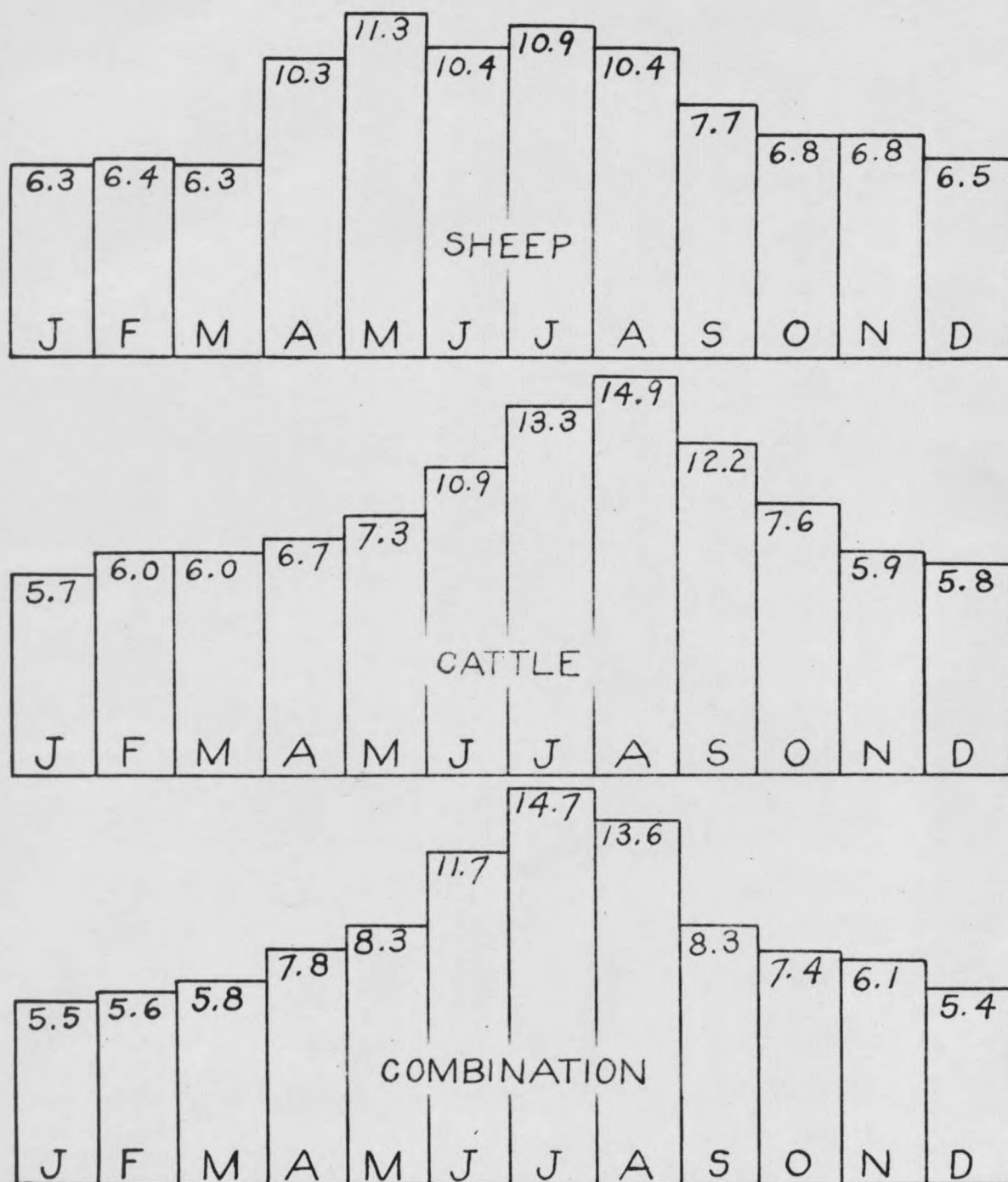


Figure 4. Percentage distribution by months of total labor used on sheep, cattle, and combination ranches, in 1941, for 64 Montana ranches.

no sheep ranches that used only family labor, while 21 percent of the cattle ranches in the sample used only family labor and 25 percent of the combination ranches used only family labor. It was discovered that the sheep ranches were more subject to a decrease in the lamb or calf crop than were either cattle or combination ranches. Fifty-three percent of the sheep operators experienced a decrease in lamb crop over 1941, while only 15 percent of the cattle ranches experienced a decrease in calf crop, compared to 15 percent of the combination ranchers. In regard to wages paid for the first seven months of 1942, the sheep ranches had to pay on the average of \$83 per month for hired help compared to \$71 per month for cattle ranches, and a relatively high figure of \$88 per month for combination ranches.

To make further comparisons the ranches were divided on the basis of area and size. It was discovered that the large plains ranchers with a labor intensity ratio of .078 used the least labor per animal unit while the average labor months used on the large size mountain ranches was .134. (See Table XLIV.) The highest substitution ratio from the plains area was from the large size ranches with a ratio of 1.270 while the largest substitution ratio from the mountains ranches was from the small size group with a ratio of 1.386. These results were not changed significantly by weighting according to universe numbers, except that the substitution ratio of the medium size plains group was found to be slightly higher than that of the large size plains group. Without a doubt and putting equal emphasis upon both considerations, the large size ranches of the plains were best

TABLE XLIV.-- COMPARISONS OF LABOR MONTHS USED PER ANIMAL UNIT IN 1941 AND RATIOS SHOWING ABILITY TO SUBSTITUTE OTHER FACTORS FOR LABOR IN 1942 ACCORDING TO LOCATION AND SIZE OF RANCH, 64 MONTANA RANCHES

Size of ranch (animal units)	Area								
	Plains			Mountains			Both areas		
	No. ¹	Int. ^{**}	Sub. ^{**}	No. ¹	Int. ^{**}	Sub. ^{**}	No. ¹	Int. ^{**}	Sub. ^{**}
	ranches	ratio	ratio	ranches	ratio	ratio	ranches	ratio	ratio
1-99	10	.396	1.263	21	.449	1.386	31	.432	1.346
100-299	6	.194	1.239	13	.314	1.244	19	.276	1.243
300 & above	6	.078	1.270	8	.134	1.095	14	.110	1.170
All sizes	22	.254	1.258	42	.348	1.287	64	.315	1.277

¹Number of ranches in sample.

^{**}The intensity ratio referred to here is the labor months required per animal unit for 1941.

^{**}The substitution ratio is the ratio obtained by dividing the index number of animal units in 1942 (1941 as the base) by the index number of labor months used in 1942 (1941 as the base).

able to substitute other factors for labor and use labor the least intensively. Within the mountains area it may be said with some degree of doubt that the large size ranches were best able to both substitute other factors for labor and use labor the least intensively. Within both areas it was found that the large size ranches distributed their labor most evenly over a year's period. The peak was more abrupt in the plains area where it occurred in May during which time 12.6 percent of the total labor was used. In the mountains area for the large size group the peak of labor use appeared in August when 12.3 percent of the total labor used was employed. For the small and medium size groups within both areas there were more intense labor use during one of the summer months than for either of the large size ranch groups from the mountains or the plains. The peaks for these small and medium size ranchers were more abrupt in the plains area.

To make comparisons of the different types of ranches for specified areas, the ranches were divided on a type of ranch and area basis. It was found (See Table XLV.) that the lowest amount of labor used per animal unit for both areas was by the sheep ranchers, who used .170 labor months per animal unit on the plains and .244 labor months per animal unit in the mountains. However, the highest substitution ratios were those of the combination ranches of both areas. These results were not changed to a very great extent by weighting according to universe numbers except for the mountain ranchers whose intensity ratios were found to be; .298 for the sheep ranches, .384 for the cattle ranches,

TABLE XLV.-- COMPARISONS OF LABOR MONTHS USED PER ANIMAL UNIT IN 1941 AND RATIOS SHOWING ABILITY TO SUBSTITUTE OTHER FACTORS FOR LABOR IN 1942 ACCORDING TO AREA AND TYPE OF RANCH, FOR 64 MONTANA RANCHES

Type of ranch	Area								
	Plains			Mountains			Both areas		
	No. ¹ ranches	Int.* ratio	Sub.** ratio	No. ¹ ranches	Int.* ratio	Sub.** ratio	No. ¹ ranches	Int.* ratio	Sub.** ratio
Sheep	6	.170	1.022	11	.244	1.335	17	.218	1.225
Cattle	10	.272	1.217	17	.353	1.150	27	.323	1.175
Combination	6	.309	1.564	14	.422	1.414	20	.388	1.459
All types	22	.254	1.258	42	.348	1.287	64	.315	1.277

¹ Number of ranches in sample.

* The intensity ratio referred to here is the labor months required per animal unit for 1941.

** The substitution ratio is the ratio obtained by dividing the index number of animal units in 1942 (1941 as the base) by the index number of labor months used in 1942 (1941 as the base).

and .279 for the combination ranches. The substitution ratios were found to be 1.372, 1.169, and 1.183 for the sheep, cattle and combination ranches, respectively. Thus, by weighting according to universe numbers it was found that the combination ranches had the lowest intensity ratio within the mountains group and that the sheep ranches had the highest substitution ratio. It can be said that the cattle ranches of the plains were best able to both use labor in the least intensive manner and to substitute other factors for labor during shortage periods. Within the mountains area there is no doubt but what the sheep ranchers were best able to both use labor the least intensively and substitute other factors for labor. The same conclusion is drawn for sheep ranches by averaging for both areas. As to effectiveness in seasonal distribution of labor, it was found that the sheep ranches in both areas distributed their labor more effectively over a year's time. The sheep ranches of the mountains, considering all the groups in this area and type breakdown, used labor the most effectively over a year's time. This group's high point was in July when they used only 11.3 percent of their total year's supply of labor. During the five months of April through August labor was used quite evenly. Within the plains area the sheep rancher's high point in labor use was in May during which time 12.5 percent of their total labor was employed. The cattle ranches in both areas had the highest peaks in seasonal labor use. For the mountains cattle ranches, their peak occurred in August during which time 16.0 percent of their total labor was used. For the plains cattle ranches the peak occurred

in July when 14.9 percent of their total labor was used.

Comparisons were further made on the basis of size and type of ranch. Within these various groups it was found (See Table XLVI.) that the large cattle ranches had the lowest labor months use ratio per animal unit, and that the small combination ranches had the highest substitution ratio. However, by taking both factors into consideration for ranches of both areas, the sheep ranches were best able to use labor in the least intensive manner and substitute other factors for labor during shortage periods. By weighting according to universe numbers, the results were not found to be significantly different except that the substitution ratio for the medium size sheep group was found to be 1.030 and for all sheep sizes was found to be 1.099.

As to labor distribution, the sheep ranches were quite consistent in all size groups in distributing their labor requirements over the year's period. The highest peak within all sheep size groups appeared for the medium size group in July when 11.9 percent of the total labor was used. Within the cattle size groups the highest peak occurred in August for the large size ranches, during which time 19.9 percent of the total labor used was employed. The cattle size groups were quite consistent in having definite monthly peaks in their use of labor. The combination outfits also were found to have had quite consistent peaks in labor use. Of all the size groups within the combination type, the highest peak appeared in July for the medium size group when 17.1 percent of its labor was used.

TABLE XLVI.— COMPARISONS OF LABOR MONTHS USED PER ANIMAL UNIT IN 1941 AND RATIOS SHOWING ABILITY TO SUBSTITUTE OTHER FACTORS FOR LABOR IN 1942 ACCORDING TO SIZE AND TYPE OF RANCH,
64 MONTANA RANCHES

Type of ranch:	Size of ranch (animal units)											
	1-99			100-299			300 & above			All sizes		
	No.*	Int.**	Sub.**	No.*	Int.**	Sub.**	No.*	Int.**	Sub.**	No.*	Int.**	Sub.**
	ranch-	ratio	ratio	ranch-	ratio	ratio	ranch-	ratio	ratio	ranch-	ratio	ratio
	es	:	:	es	:	:	es	:	:	es	:	:
Sheep	1	.450	.974	8	.277	1.275	8	.130	1.206	17	.218	1.225
Cattle	18	.352	1.176	6	.361	1.285	3	.070	.949	27	.323	1.175
Combination	12	.551	1.632	5	.173	1.140	3	.097	1.295	20	.388	1.457
All types	31	.432	1.346	19	.276	1.243	14	.110	1.170	64	.315	1.277

* Number of ranches in sample.

**The intensity ratio referred to here is the labor months required per animal unit for 1941.

***The substitution ratio obtained by dividing the index number of animal units in 1942 (1941 as the base) by the index number of labor months used in 1942 (1941 as the base).

Table XLVII presents the substitution and intensity ratios of all the groups included in the study. Obviously, some of the groups were so small that little could be said that would represent that particular group as a whole. For all of the 64 ranches included within the study, it was observed that they used on the average .315 labor months per animal unit and had an average substitution ratio of 1.277. As to the effectiveness of the labor distribution over a year's time it was discovered that the major demand for labor came during the months from April to August. (See figure 5.) The peak occurred in July and August when 12.3 percent and 12.2 percent respectively of all the labor was used. The average monthly wage paid for the first seven months of 1942 was \$81. The average ratio of land per animal unit was 21 acres and the average ratio of cultivated land per animal unit was .325 acres. The average number of animal units run on the ranches was 298, and the average size ranch was 9,470 acres.

This concludes the major part of our analysis, which throughout determinations have been analyzed in regard to intensity of labor use and ability to substitute other factors for labor on ranches according to size and type of ranch for specified areas in Montana. Supplemented with these determinations an analysis of the effectiveness of seasonal labor distribution has been made.

To further understand the degree of association between substitutability and intensity of labor use, a correlation analysis was run between these two variables. The following formula was used:

TABLE XLVII.-- COMPARISONS OF LABOR MONTHS USED PER ANIMAL UNIT IN 1941 AND RATIOS SHOWING ABILITY TO SUBSTITUTE OTHER FACTORS FOR LABOR IN 1942 ACCORDING TO LOCATION, SIZE, AND TYPE OF RANCH, 64 MONTANA RANCHES

Type of ranch	Size of ranch :(animal units)	Area								
		Plains			Mountains			Both areas		
		No.*	Int.**	Sub.**	No.*	Int.**	Sub.**	No.*	Int.**	Sub.**
		ranches	ratio	ratio	ranches	ratio	ratio	ranches	ratio	ratio
Sheep	1-99	1	.450	.974	-	-	-	1	.450	.974
	100-299	2	.164	.861	6	.315	1.413	8	.277	1.275
	300 & above	3	.081	1.145	5	.159	1.242	8	.130	1.206
	All sizes	6	.170	1.022	11	.244	1.335	17	.218	1.225
Cattle	1-99	7	.321	1.156	11	.372	1.189	18	.352	1.176
	100-299	2	.219	1.420	4	.433	1.217	6	.361	1.285
	300 & above	1	.038	1.240	2	.087	.804	3	.070	.949
	All sizes	10	.272	1.217	17	.353	1.150	27	.323	1.175
Combination	1-99	2	.635	1.783	10	.534	1.602	12	.551	1.632
	100-299	2	.200	1.436	3	.156	.943	5	.173	1.140
	300 & above	2	.093	1.473	1	.105	.939	3	.097	1.295
	All sizes	6	.309	1.564	14	.422	1.414	20	.388	1.459
All types	1-99	10	.396	1.263	21	.449	1.386	31	.432	1.346
	100-299	6	.194	1.239	13	.314	1.244	19	.276	1.243
	300 & above	6	.078	1.270	8	.134	1.095	14	.110	1.170
	All sizes	22	.254	1.258	42	.348	1.287	64	.315	1.277

*Number of ranches in sample.

*The intensity ratio referred to here is the labor months required per animal unit for 1941.

**The substitution ratio is the ratio obtained by dividing the index number of animal units in 1942 (1941 as the base) by the index number of labor months used in 1942 (1941 as the base).

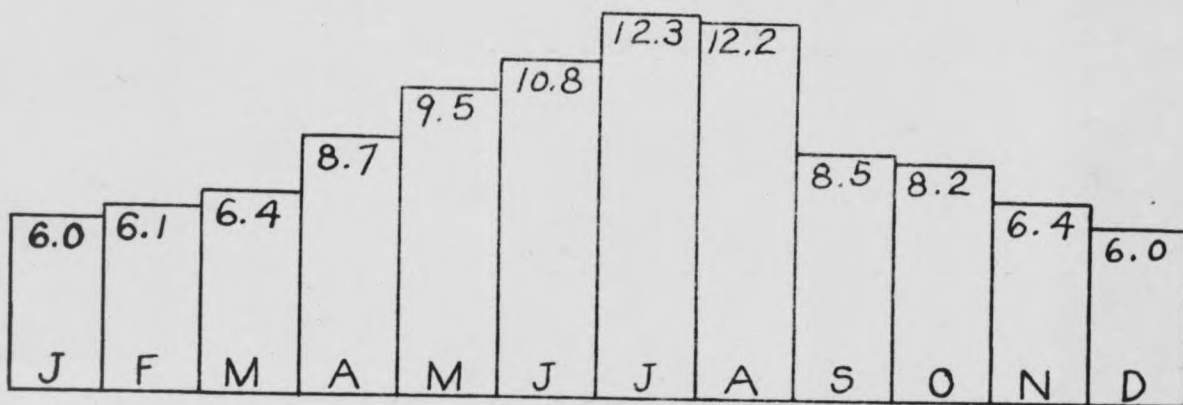


Figure 5. Percentage distribution by months of total labor used, in 1941, for 64 Montana ranches.

$$R = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{N\sum X^2 - (\sum X)^2} \sqrt{N\sum Y^2 - (\sum Y)^2}}$$

The correlation coefficient determined was .457, which although is a low coefficient, indicates that there was a positive degree of association between substitutability and intensity of labor use. Applying a test of significance, it was found that the coefficient itself was highly significant. By squaring the coefficient it is possible to determine how much of the variation can be attributed to the coefficient itself or to the interrelationship of the two variables. It was found by this process that approximately 21 percent of the variation was due to the relationship between substitutability and intensity of labor use.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The purpose of this study was to make comparisons of the variations in the ability of ranchers to substitute other factors for labor during shortage periods, of the variations in intensity of labor use, and of the variations in the effectiveness by which labor use is distributed over a year's time, for 64 ranches according to size and type of ranch for specified areas in Montana. An additional purpose was to determine how ranchers substitute for labor during shortage periods.

For the two areas studied, the ranchers of the plains area used labor the least intensively with .254 labor months used per animal unit, compared with .348 labor months used per animal unit on the mountain ranches. The average for ranches of both areas was .315. It was observed for the sample used that the differences between the ratios showing the ability to substitute other factors for labor during shortage periods was not significant. The average substitution ratio was determined as 1.277, which indicates that on the average the ranchers studied were able to substitute for labor quite readily. As to seasonal labor distribution, it was found that the ranchers of plains were best able to spread their requirements for labor over the year's period, the peak occurring in July during which time 12.2 percent of their total labor was used. This was compared to a peak of 12.9 percent for the mountains ranchers, and it was observed that the peak was more abrupt for this area falling off by 4.5 percent for the month of September. It is concluded by placing

equal emphasis on all three factors that the plains ranchers were best able to use labor in the least intensive manner, as well as substitute to the greatest extent and use their labor the most effectively over a year's time.

For the various size groups included in this study, it was observed that the large ranchers used labor the least intensively requiring only .110 labor months per animal unit compared with .276 and .432 labor months respectively for the medium and small size outfits. In regard to substitutability, it was found that by weighting the substitution ratios of the various groups classified according to size, type, and area by universe numbers that the medium size ranchers were best able to substitute other factors for labor during shortage periods. However, the average substitution ratios for the ranches of this sample were determined to have been 1.346 for the small ranches, 1.243 for the medium size ranches, and 1.170 for the large ranches. As to effectiveness in labor use, it was discovered that the large size ranchers spread their labor requirements over a year's time most effectively. Their high peaks occurred during May and August during which for each month 11.5 percent of the total labor was used. The high peak for the medium size group appeared in July during which time 14.4 percent of their labor was used, and for the small group the peak appeared in July during which time 13.2 percent of their total labor was used. It is concluded by taking all three factors into consideration that the large ranchers were best able to, not only use labor the least intensively but to substitute for labor during shortage periods

and use their labor most effectively over the year's time.

Breaking the ranches down according to type of ranch, it was found that the sheep ranchers used labor in the least intensive manner with a labor intensity ratio of .218 labor months used per animal unit maintained. This was compared to .323 labor months used per animal unit for the cattle ranches and .388 labor months used per animal unit for the combination ranches. However, it should be remembered that the main reason why sheep ranchers have a lower average labor intensity ratio than do either the cattle or combination ranchers is because in the sample and in the parent population, there were relatively few small sheep ranches with high intensity ratios, while there was a large number of small ranches in the cattle and combination groups, especially in the cattle groups. The combination ranches were best able to substitute for labor during shortage periods with a substitution ratio of 1.459, compared to substitution ratios of 1.225 for the sheep ranches and 1.175 for the cattle ranches. However, by weighting according to universe numbers the following substitution ratios were determined, combination ranches-- 1.415, cattle ranches-- 1.211, and sheep ranches-- 1.099.

In regard to effectiveness in seasonal labor use it was found that the sheep ranchers were best able to distribute their labor requirements over the year's time and that during the five months from April through August labor was used quite consistently. The peak occurred in May during which time 11.3 percent of their total labor was used. The peaks for the cattle ranches occurred in August during which time 14.9 percent of their

total labor was used, and for the combination ranches appeared in July during which time 14.7 percent of their total labor was employed. It is concluded by putting equal emphasis upon each of the three considerations that the sheep ranchers were best able to use labor least intensively, to substitute for labor during shortage periods, and distribute their labor requirements out over a year's period.

In considering how ranchers substitute for labor it was found that they substitute other kinds and types of labor inputs, capital, in the form of machinery and animal units, land, in the form of sacrificing conservation, and management, in the form of using different types of management. In the process of substituting different kinds of labor input it was discovered that ranchers were substituting labor inputs of a later date, in that they were letting their general repair work go until labor could be hired at lower wages and in sufficient quantity. It was disclosed that ranchers were substituting a different type of labor input in that they were making use of exchange work to a greater extent, and in that they were hiring less experienced help.

In the process of substituting land for labor, actual data on which to make determinations was unavailable, but from comments received by the author, it was found that the ranchers where possible were running more animal units on the same amount of land in response to higher prices and heavier rainfall. The ranchers were also substituting capital for labor in that many of them were making use of more machinery, especially haying equipment. Too, they were running more animal units, which is a

form of capital stock, in proportion to the amount of labor used.

In the realm of management, the ranchers were found to be adapting different types of management. Many, especially were decreasing their crop and hay acreage. Many were changing the type of season, and were taking losses in lambs and calves. Many were not getting their general work done on time. This was especially true of haying operations where they were taking losses in coarser feed. In addition, many ranchers were spending less time with their management activities, so they could do more of the manual work on the ranch.

As a final statement it was concluded that ranchers are able to substitute other factors for labor to quite a great extent, that the proportional decrease in animal units maintained on ranches is not as great as the proportional decrease in labor used. This is evident by the relatively high average substitution ratio of the 64 ranches studied which was determined as 1.277.

APPENDIX

When it was found that the sample of 64 ranches used in this study was not representative, and that some of the averages would, no doubt be distorted because of the influence of the frequencies within the various groups, it was decided to seek information that would give the frequencies of the various groups that resulted when the ranches were classified according to size, type and location. A study of 9130 ranches conducted by Leon C. Michaelson^{1/} in 1938 was found to contain information as to numbers that could be arranged into the groups used for this study. (See Appendix Table I.) These frequencies were worked out as a basis for recomputing the substitution ratios and the intensity ratios. In order to do this, the intensity and the substitution ratios of the individual groups classified according to size, type and location were assumed to be representative of the class within which they fell, and the averages for the all-size, all-type and all-area ranches were computed, by using the adjusted frequencies. (See Appendix Table II.)

^{1/} Michaelson, Leon C., Size, Income and Organization of Ranches, Montana State College Thesis, Bozeman, Montana, June, 1938, pp 38 and 43.

TABLE I.-- DISTRIBUTION OF RANCHES IN MONTANA* ACCORDING TO SIZE,
TYPE AND LOCATION ON THE BASIS OF 1000

Type of : ranch :	Size of ranch : (animal units) :	Plains	Mountains	Both areas
Sheep	1-99	41	13	54
	100-299	45	20	65
	300 & above	35	19	54
	All sizes	121	52	173
Cattle	1-99	305	158	463
	100-299	125	64	189
	300 & above	32	17	49
	All sizes	462	239	701
Combination	1-99	28	19	47
	100-299	25	18	43
	300 & above	21	15	36
	All sizes	74	52	126
All types	1-99	374	190	564
	100-299	195	102	297
	300 & above	88	51	139
	All sizes	657	343	1000

*These frequency distribution numbers were obtained from Michaelson, Leon C., Size, Income, and Organization of Ranches, Montana State College Thesis, June, 1938, pp. 38 and 43.

TABLE II.-- COMPARISONS OF LABOR INTENSITY RATIOS* AND SUBSTITUTION RATIOS** FOR RANCHES IN MONTANA ACCORDING TO TYPE, SIZE AND AREA, COMPUTED ON A WEIGHTED FREQUENCY BASIS, 1941-1942

Type of ranch:	Size of ranch :(animal units):	Area								
		Plains			Mountains			Both areas		
		: Freq. :	ratio:	Sub.**:	: Freq. :	ratio:	Sub.**:	: Freq. :	ratio:	Sub.**:
Sheep	1-99	41	.450	.974	13	.475	1.500	54	.456	1.101
	100-299	45	.164	.860	20	.315	1.413	65	.210	1.030
	300 & above	35	.081	1.145	19	.159	1.242	54	.108	1.179
	All sizes	121	.237	.981	52	.298	1.372	173	.255	1.099
Cattle	1-99	305	.321	1.156	158	.372	1.189	463	.338	1.167
	100-299	125	.219	1.420	64	.433	1.217	189	.291	1.351
	300 & above	32	.038	1.240	17	.087	.804	49	.055	1.089
	All sizes	462	.274	1.233	239	.384	1.169	701	.306	1.211
Combination	1-99	28	.635	1.783	19	.534	1.602	47	.594	1.710
	100-299	25	.200	1.436	18	.156	.943	43	.182	1.230
	300 & above	21	.093	1.473	15	.105	.939	36	.098	1.250
	All sizes	74	.334	1.578	52	.279	1.183	126	.312	1.415
All types	1-99	374	.359	1.183	190	.395	1.252	564	.371	1.206
	100-299	195	.204	1.293	102	.361	1.207	297	.258	1.263
	300 & above	88	.068	1.258	51	.119	1.007	139	.087	1.166
	All sizes	657	.274	1.226	343	.344	1.202	1000	.298	1.217

*Number of ranches in weighted sample.

*The intensity ratio referred to here is the labor months used per animal unit for 1941.

**The substitution ratio is the ratio obtained by dividing the index number of animal units in 1942 (1941 as the base) by the index number of labor months used in 1942 (1941 as the base).

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Labor use on livestock
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